LECTURES

ON

ANATOMY:

INTERSPERSED WITH PRACTICAL REMARKS.

VOL. II.

By B. B. COOPER, F.R.S.,

SURGEON OF GUY'S HOSPITAL, LECTURER ON ANATOMY,

&c. &c. &c.

LONDON:

LONGMAN, REES, ORME, BROWN AND GREEN, PATERNOSTER ROW;
S. HIGHLEY, FLEET STREET; AND THE MEDICAL
BOOKSELLERS IN LONDON, DUBLIN
AND EDINBURGH.

1830.

F. WARR, PRINTER,
RED LION PASSAGE, HOLBORN, LONDON.

INTRODUCTION.

I have in this Volume endeavoured to follow up my original plan, of placing before my Pupils a general outline of my Lectures as delivered in the Anatomical School of Guy's Hospital.

This portion of my projected work will be found to comprise the General and Descriptive Anatomy of Muscles, Cellular Membrane, and the common Integuments; thus concluding the exterior structures of the body.

My object has been to render the subject clear to the Pupil, in the direct progress of his anatomical studies; which may have betrayed me occasionally into prolixity and tautology. I have, however, steadily kept the advantage of my plan in view; which has been to present a correct course of anatomy, combined with surgical and physiological remarks: regarding the utility of my purpose more, than the production of an elaborate or erudite performance.

London, 1830.

CONTENTS.

PAGE.

LECTURE XVII.

Descriptive Anatomy of Muscles.

LECTURE XVIII.

Descriptive Anatomy of Muscles.

LECTURE XIX.

Descriptive Anatomy of Muscles.

Classification of Muscles.

PAGE.

Table of the Muscles.

It is expected, that this Work will be comprised in Four Volumes. Vol. III. will contain the Anatomy, with the Physiological and Surgical Remarks, of the Interior Parts of the body. Vol. IV., the Brain, Nerves, and Organs of the Senses.

LECTURES ON ANATOMY.

PART IV.

GENERAL ANATOMY OF MUSCLES.

LECTURE XII.

GENERAL ANATOMY OF MUSCLES.

The muscular system comprehends that soft part of the body which is, in common language, termed flesh: the substance itself, from the power it possesses of contraction, has been denominated muscle from the greek μευειν, to contract. This faculty cannot be traced to any chemical or mechanical effect, but to a peculiar inherent tendency the muscular fibre has to shorten, upon the application of a stimulus, which, in ordinary circumstances, is communicated to it through the nervous system.

As this is the structure which gives motion to the solids as well as to the fluids, and indeed regulates the locomotive power of the whole body, it forms, as might be supposed from the variety of functions in which it so actively assists, a very considerable part of the corporeal substance, adding much to the weight and marking the general outline and contour of the human frame; for although the skeleton bears so strong a resemblance to the figure of the body, yet the eye of the anatomist cannot dwell for a moment on the articulated bones without seeing the necessity for other structures to determine the rounded exterior form of the human subject.

I shall now proceed to describe the general characteristics and physical properties of this system, that it may at once be distinguished from the other systems and tissues which enter into the composition of the human body.

The muscular system may at once be recognised and distinguished from the other parts of the organismus, being composed of a number of fleshy fasciculi, which are soft, moist, slightly elastic and semi-transparent; formed of longitudinal and parallel fibres, which are irritable and contractile;

and, in warm-blooded animals, of a red colour. But upon a more minute examination as the muscle lies in masses in a relative position, or investigating it more closely when separated from the body, it is found to be composed, not of one homogenious structure, but of three distinct tissues:—fleshy fasciculi, tendinous fibres, and cellular membrane; each of which structures is essential to the function of the muscular system, although to one only of them is attributable that contractile power which marks vital property; and to these may be added,—arteries, veins, nerves, and absorbents. The *fleshy fibres* of the muscles are disposed in fasciculi, which are placed by the side of each other, and never intersect: these fasciculi are separable into fibres, these again into smaller fibrillæ, and even these may be subdivided until you expose what has been termed the ultimate fibre, which is so small as only to be visible by the aid of a microscope, but which some believe to be of itself only indivisible for the want of delicacy of manipulation and niceness of instruments. There are physiologists who maintain that the primitive fibres, as they have been called, are of considerable length, and extend, in many muscles, from their tendinous origin to their tendinous insertion; this opinion, however, is not generally believed; on the contrary, it is thought that each of these lengthened fasciculi is made up of a number of the ultimate fibres connected with each other at their extremities through the medium of the cellular membrane.

The difficulty of ascertaining the true structure and organization of the ultimate fibre of a muscle may be supposed, when it is estimated as not surpassing one two-thousandth part of an inch in diameter; and therefore, on this point, a great difference of opinion exists: some affirming that it is solid, and consists of a substance resembling the fibrine of the blood, enclosed in a reticulated membrane: others, that it is a hollow cylinder: again, that they are composed of rounded corpuscles, placed like a series of pearls, connected by cellular tissue: but it seems too true, that their real structure has not been ascertained; although, from the different

opinions I have read, and from my own observations and inspection of fresh and boiled muscular fibre, I feel disposed to believe, with Meckel, that the muscles are solid, and probably composed of the fibrine of the bood, modified by the vessels which are destined to deposit this peculiar structure. The red colour of the muscular fibres in vertebral animals is generally attributed to the blood; because, in exposing muscle to a running stream, the colour disappears as the blood is washed away: but the circumstance of their paleness in the amphibia, and also their perfect whiteness in red-blooded worms, proves that their colour depends upon something besides the blood. It has been supposed by some to result from the aromatic constituent of the muscle, termed osmazome.

The *cellular membrane* of the muscles is a soft spongy tissue, which not only affords them a general covering of greater or less density, but envelopes every fasciculus, and, ultimately, every fibre, and also fills up the interstices between its separate divisions; forming here, as in every part of the body, the great medium of connexion as well as separation: nor is this the only use it affords to the muscular system, for its cells secrete an albuminous fluid, which, together with a considerable quantity of fat, tend to lubricate their surfaces, and necessarily facilitate their motions.

An *adipose membrane* is also found surrounding the muscles: at certain periods of life it only covers them externally, being between them and the skin; while, at later periods, it is found between the fasciculi which compose the muscle; and, in old age, between the very fibres themselves.

The *tendinous fibres*, which are connected with those of the muscles, appertain chiefly to the external or locomotive muscles, and form the medium of their connexion to the bones: these fibres are easily distinguishable from the fleshy fibres, being of a white silvery lustre, and not possessing any contractile power: they belong to the fibrous system of the body; and their organization, physical properties, and general characters will be described when treating particularly of that

tissue. Their use to the muscular fibre is, to concentrate the force of its contractile power, and to diminish the surface for their insertion into bone, which must necessarily have been much more extensive had the fleshy fibres themselves been connected to the osseous system; and they further regulate and modify the force and direction of their action. These tendinous fibres are not always for the purpose of forming the points of attachment of muscles; they are sometimes found in the very substance of the muscles; in fact, they are subject to many varieties of situation in the muscular system, which will be pointed out when describing in detail the classification of the muscles. The strength of the tendons seems to depend rather upon the peculiar conformation of its tissue than upon any vital principle, which is evinced by its retaining all its physical powers even after death

Blood-vessels are found in great abundance in all the muscles, but not in all alike, as will be hereafter more particularly mentioned.

The *arteries* are sufficiently large to be demonstrated, so that their course may be traced; and their larger trunks are found entering towards the centre of a muscle, where they immediately divide into smaller ramifications, which are equally destined to supply the true fleshy fibre, the tendinous and the investing cellular membrane. Those which supply the fleshy fibres convey the red particles of the blood; from which circumstance, as well as from their size, they may be observed to divide into two sets of ramifications; one distributed to the superficial, while the other, including the greater number, supplies the deeper fibres; and it is supposed that the ultimate ramifications of these vessels are as numerous as the ultimate fibres which constitute the muscle. The arteries of this system increase in size in proportion to the degree of action to which the muscle is exposed, and are also materially influenced in this respect by the health and age of the subject; hence the redness of the wings of birds of flight, and the comparative whiteness of the muscles of their legs, which proves that the redness of the muscular system is derived, in

some measure at least, from the blood. The arteries which supply the tendinous fibres of the muscles are smaller than those which supply the fleshy fibres, and are destined to convey only the transparent parts of the blood, so that they are with difficulty demonstrated; while the vessels which supply the cellular membrane, although very small, do convey some slight colouring matter, which proves that the different ramifications of the same trunk are capable, not only of being distributed to different tissues, but also of yielding only such parts of the blood to them as can be assimilated, and assume the character of that structure of which they are destined to form a part. It is found that the larger trunks of arteries, as they pass through the muscular system to distant parts, are deeply situated, and are placed in such circumstances as to be protected from external injury.

The *veins* which return that portion of the blood from the muscular system which is not employed for their growth, development, and function, are distributed in two sets; the one being situated in the interior of muscles, accompanying the arteries, while the other is observed running upon the surface of the muscles: the object of this appears to be, that, during the action and consequent contraction of a muscle, the flow of blood through the veins towards the heart should not be impeded; hence the phenomenon of the superficial veins becoming distended with blood when the muscles of the arm are put into a state of contraction. The veins have a greater capacity than the arteries: they commence, by the minutest ramification, from the ultimate fibre of the muscle, into which an equally small ramification of an artery had terminated; and then, forming frequent anastomoses in the surrounding cellular membrane, produce the larger superficial branches, and take their course towards the heart. The veins of the muscular system have been supposed by Bichat not to be supplied with so many valves as the veins of the other structures; but he seems to infer it only from the supposition that they do not require them in consequence of the support they derive from the muscles themselves, which form a substitute

for them by taking off the pressure of the column of blood from their coats.

The *absorbents* of muscles, neither in structure nor in distribution, offer any thing peculiar; they are rather supposed than proved to arise by a minute ramification from the ultimate fibre, and then proceeding with the blood vessels to the surface of the muscle, they may be demonstrated taking their course in the interstitial spaces of the fasciculi with the veins, proceeding with them until they enter the gland, into which they penetrate before they reach the thoracic duct. It may be presumed, that this system is proportionably as freely distributed to the muscles as to the blood-vessels and nerves, which are so abundant.

The *nerves* of the muscular system are both numerous and large, more especially those nerves which supply the external muscles; while the muscles internally seated receive fewer filaments, and from a different source. Again, there are intermediate muscles which receive their nerves from both sources, and have properties peculiar to each class: but this grand division of the muscular system will be described in detail, after the general attributes of muscle have been treated. Thus the muscles derive their nerves from three sources:—the brain, the spinal marrow, and the sympathetic; and from these they proceed as nervous cords accompanying the blood-vessels, more particularly the arteries; they form frequent plexuses from which several muscles are supplied, probably for the purpose of producing a reciprocal and simultaneous action; but this will be further investigated when speaking of the properties of the muscular fibre. The manner in which the filaments of these nervous cords are distributed to the muscles is difficult to comprehend, from the extreme minuteness of their division, which has led to a variety of opinions on the subject. It is considered by some, that they subdivide into as many filaments as there are fibres of the muscles to which they are distributed; so that each ultimate fibre receives an artery and a filament of the nerve, and sends off from it a vein and an absorbent: others are of opinion, that the nerves

do not enter the minutest parts of a muscle as a cord, but that the neurilema ceases, and that the soft medullary part of the nerve alone enters into its composition. The cellular membrane is supposed by some physiologists capable of becoming a medium of communication between the nerve and the muscular fibre, without the direct entrance of the nerve itself into the muscle: and, again, there are authors who believe that the nerves, in whichever of these modes they may reach the muscle, are not distributed to all of its fibres, but only to a few; which, being stimulated to contract from the influence of the nerve, produce by their action the stimulus of contraction to the rest of the fibres in the direct line of continuity, so that only a part of a muscle need be in a state of contraction. Reil had yet another hypothesis:—that a nerve was capable of extending its influence to some distance from its termination, by what he termed its "*nervous atmosphere*." That there should be so many opinions proves only the difficulty of arriving at precise conclusions; a difficulty arising principally from the minuteness of the structure upon which the vital properties of the muscular system depend. That it is the nerves, however, which induce the contractile state of muscle, is negatively proved by the experiment of dividing the trunk of a nerve in its passage to a muscle, when its voluntary power of contraction ceases, although it may yet be stimulated to action by mechanical or chemical agents. It may be observed, that the greatest part of the cerebral system of nerves are distributed to the muscles, and that they bear generally a proportionable size to the muscle upon which they ramify. If a muscle is destined to assist in the performance of more than one function, it is supplied with nerves from more than one source; a circumstance beautifully illustrated by the physiological and philosophical discoveries of Mr. C. Bell, to whose scientific attainments too high a tribute of respect cannot be paid.

Chemical Analysis.

The muscles have been already described as having several

structures and systems entering into their composition; we accordingly find, that they afford various substances when exposed to chemical analysis; but it may be justly said that there is but one constituent which forms the distinguishing characteristic of this system,—the fleshy fibre, which is proved to be very analagous to the fibrine of blood. The red colour which the muscular fibre possesses is not peculiar to it; for by cutting the fibre into very minute pieces, the colour may be completely extracted. Berzelius, from the result of his experiments, has given the following analysis of the muscular system; but, before the precise substances are mentioned, it may be well perhaps to inform the student, that all animal matter differs from vegetable, in having an additional elementary constituent, namely, nitrogen; carbon, hydrogen, and oxygen, alone forming the elementary bases of vegetable matter.

An hundred parts of dried muscle, according to Pfaff, as quoted by Meckel, consisted of the following proportions of the elements of animal matter:—

Carbon	48	30
Hydrogen	10	64
Nitrogen	15	92
Oxygen	17	64
	92	50
Fixed Salts	7	50
	100	00

The other substances which compose muscle, are divided by Berzelius into those which are solid, and those which are fluid.

Solids.

Muscular fibres, vessels and nerves	15	8
Fibres and cellular membrane dissolved by decoction	1	9
	17	7

Fluids.

Muriate and lactate of soda . .	1	80
Coagulated albumen and fibrine .	2	20
Phosphate of soda	0	90
Extractive, soluble in water only .	0	15
Phosphate of lime with albumen .	0	08
Water and loss	77	17
	100	00

Berzelius also speaks of the presence of a free acid, which he terms lactyne. Besides these constituents is found a peculiar extractive matter of a brown colour, of a pungent taste, and of an aromatic odour, which has been named osmazome by M. Thenart, and by him is supposed to be the principal source of the flavour of the flesh of animals.

The stronger acids and caustic alkalies act freely upon muscle, and will ultimately dissolve it; during this action a considerable quantity of gas is evolved; and if nitric acid be used, nitrogen is disengaged: the same phenomenon occurs if nitric acid be poured upon other animal substances, but not to the same extent as where muscular fibre is exposed to its influence. If muscle be exposed for a length of time to a slow running stream of water, it becomes converted into a substance of an unctuous quality very much resembling spermaceti, and which is called adipocire; this process is quickened if muscle be subjected to the action of diluted nitric acid. The spontaneous conversion of the bodies of those buried in a certain part of Paris, is a peculiar instance of this chemical change: there is also another instance of it on record in this metropolis in two bodies, which had been buried many years in the church-yard of St. Saviour, Southwark, which were found completely converted into this substance.

Properties of Muscle.

The muscular fibre, in common with every other modification of matter, possesses certain properties connected with

its form, texture and external character; but superadded to these it also displays powers which distinguish it as forming a considerable part of a *living* organized body: hence it is, that the properties of muscle have been rightly divided by all physiologists into physical and vital.

The *physical properties* of the muscular fibre depend upon its form, structure, and general external characters; and may be considered to be flexibility, extensibility, adhesiveness, and elasticity. These properties, however, are with considerable difficulty appreciated, in consequence of the various structures which surround and connect them; a difficulty, too, not a little enhanced in many instances by the influence of divers circumstances affecting the muscles, either before or subsequent to death. Subjected to the action of cold, they lose much of their red colour as well as a large proportion of their weight, becoming hard, of a brown colour, and semitransparent; changes greatly accelerated by exposing them to the action of a current of dry air. By maceration, a muscle undergoes several changes, which vary with the kind of fluid to which it is exposed: thus, alcohol and diluted acids cause it to soften and swell; a solution of corrosive sublimate, or alum, causes its fibres to separate by the shrinking of the cellular membrane surrounding them, and increases the consistency of the muscular fibre itself by inducing its contraction. A solution of common salt will produce the same effect of rendering it harder; and, at the same time, will increase the redness of its colour. If muscle be exposed to the process of boiling for a considerable time, its fibres become entirely colourless, are easily separable, and, if analysed, are found to resemble the fibrine of the blood, like it, becoming fragile when cold. If exposed to a strong dry heat, so as to be calcined, it is said by Berzelius to leave a saline matter amounting to one-twentieth part of its weight. The physical elasticity of the muscular fibre,—which is mentioned by some physiologists, and which is contended for in consequence of the apparent power a muscle has to

assume its natural size after it has been stretched by some mechanical pressure, as after ascites or parturition,—is doubtful; it being a question whether this apparent physical elasticity belongs to muscle, or to the surrounding tissues; for we find after death, at least, that it loses this power upon the separation of its cellular coverings, when it is very readily torn.

Vital properties are those by which the functions of the muscular system are produced. During life, the muscles are observed to possess and to exercise a power which is termed contractility; the capacity for which is designated irritability. By contractility is meant, that power by which a muscle, from the application of a stimulus, is capable of shortening itself; and it is in consequence of this inherent power, that all their actions are performed. A muscle, when in a state of contraction, becomes harder, thicker, broader, proportionably shorter, and transversely wrinkled, and their fibres are observed to manifest a trembling or oscillating motion, which is owing to their alternately contracting and relaxing; and they are further found by experiment to have acquired considerable strength, which seems obvious from the fact, that muscles are less capable of resisting injury from external violence during their passive or relaxed state. Such is the state, as usually described, of a muscle when in action; but there is reason for entertaining some doubts as to the accuracy of the account given. Is it, for instance, certain, that the muscular fibres of a muscle are of necessity shortened during contraction; or, may it not be, that the muscle is only thrown into the form of a bow, as its two extremities are made to approach each other? For if we attempt to raise a weight too great for our muscular power, the muscles are put into the greatest possible state of action, and yet no shortening can occur; so that it may be said, that the shortening depends upon the degree of stimulus being greater than that of the resistance. The apparent thickness and increase of hardness in a contracted muscle, may also be attributed to its change of place

by bowing forwards when in action. The widening of a muscle is also doubtful, while it is in a state of contraction; for that appearance, and also the wrinkled state, seems to be produced, rather by those fibres which are not contracted than those which are, as well as by the cellular membrane; so that it seems probable, that the fibres of a muscle during action, where the stimulus is capable of overcoming the resistance, produces an approximation of every fibre in action, diminishing at the same time both the length and breadth of a muscle, and, consequently, diminishing also its bulk and producing its hardness. There has, however, been much variance of opinion upon the subject of the enlargement or diminution of muscle during its contraction; and experiments have been instituted by physiologists to discover their actual state, although nothing very conclusive has ever been ascertained. Glisson seemed to conclude, from his experiments, that the muscle was actually diminished in bulk during contraction. Sir Anthony Carlisle considered that their bulk was increased, and produced therefore a rising of the fluid, into which the living arm of a man was immersed: while Sir Gilbert Blane was of opinion, that no change of bulk was evident during the contracted state of the muscular fibre; and his experiment was made by enclosing a living eel in a vessel, the neck of which was drawn out in a fine tube, when, by irritating the animal so as to produce its contraction, the fluid was found to remain perfectly stationary in the tube of the vessel: but they all agree, that the muscle becomes harder while in action; of which we have a ready proof by feeling our masseter muscle while at rest, and during the process of mastication. It is also a question as to the quantity of blood in a muscle during its state of contraction, whether or not there be less at that time than when in a state of relaxation: the latter we are led to believe, from a change of colour which is said to be observed during its action; as well as from the fact, that the blood flows more readily from the superficial veins when the muscles are made forcibly to contract. Hence it seems

that less is allowed to pass into their substance: and if this be proved, it would also be an argument for the diminution of bulk in muscle during its activity. There are, however, some reasons for doubting that the quantity of blood in muscle is diminished during its contraction; for the experiment which the physiologists who are of that opinion have taken to prove it, cannot be considered as conclusive: they have examined the heart of a frog, which they describe as becoming pale during contraction; but this appearance is owing to the transparency of the ventricles, transmitting therefore a deeper red at the time they are full of blood, which has no bearing upon the question before us.

During the contraction of muscle, little or no sensation is produced in the contracting part, but only in the part pressed; this is proved by clenching the fingers, when the palm of the hand is felt, but no sensation along the muscles of the fingers: indeed it has been believed, that muscle has no sensation during its active state of contraction; and it has been alleged from the experiment, to which many people voluntarily subject themselves, of pushing pins into the calves of the legs; yet a long continued forcible action is itself a very painful sensation, as every pupil taking lessons in dancing and fencing will readily acknowledge.

While a muscle is contracting, there is said to be a continual agitation of its fibres, which has already been described as being produced by the alternate relaxation and contraction of them; and it is also said, that by examining a muscle while in action through a stethoscope, a noise may be heard; and if the little finger be pressed into the meatus auditorius, the same noise is heard, which Dr. Woollaston attributed to the motion of the muscular fibres of the arm; but some philosophers have considered it to be produced by the flow of blood through the vessels, which seems to be most probable, as the noise, if attended to, will be found to be syncronous with the pulse. The quickness with which muscular contraction is effected is very considerable, and can but excite wonder when we

consider the various muscles employed in running, speaking, &c. The power exercised by the muscles when in action is enormous, so great as sometimes to break the bones to which they are attached: the force is necessarily always in proportion to the number of fibres in action. The extent of muscular contraction is generally in proportion to the length of the muscular fibres, and is increased when nothing is opposed to it, as becomes evident in cases of fractures. The extent to which muscles are said to have the power of contracting themselves, is computed by physiologists to be to a fourth of their length of those which serve for the animal functions; while the involuntary, or those of the vegetative life, contract to one third: but it is doubtful if much reliance can be placed upon this observation.

The chief and prime cause of muscular contraction, is a vital principle, which gives to the muscle that peculiar power, by which its whole economy is regulated. There is, however, a necessary condition for the muscular system to render it susceptible to the stimuli which produces its contraction; it must, in fact, be participating in the general circulation of the blood, and be connected with the centres of the nervous system; and if there be any circumstance which removes it from these influences, or in any way produces an interruption to these communications, there is always, sooner or later, a cessation of its action, Bruises, or injury to the surrounding cellular tissue of muscles, will also diminish, and sometimes deprive them of their contractile power.

Muscle in a state of relaxation is placed under precisely the reverse circumstances to those attending its state of contraction; the belly becomes soft, the bowed direction of its fibres is lost, its transverse wrinkles disappear, its extremities no longer tend to approximate, and the whole muscle is quiescent. With respect to this state of relaxation, a question arises, whether it be merely a cessation of action, or, that there is an active power necessary to restore them to their natural passive situation;

for, as there are antagonists to every muscle, an elastic substance surrounding them, and also the laws of gravity acting upon them in their quiescent state,—all these may be considered as forces producing the relaxation after the contraction of muscular fibre, which, consequently, cannot be considered as mere cessation of contraction only.

Having now spoken of the irritability of muscular fibre, which means its susceptibility to receive impressions from stimuli; we have now to describe what are the kind of stimulants which produce contraction of muscle, and through what medium they communicate the impression.

The kind of stimulants have by many physiologists been divided into *vital*, *mechanical*, and *chemical*.

Those of the first class act through the medium of the brain, and consist of the influence of the will, and such violent emotions of the mind as are termed passions; but in order that the will may operate as a stimulus to a muscle, it is necessary that there be a direct communication between the muscle and the brain by means of a nervous cord. The following facts prove this assertion:—if we will, for instance, to flex the arm, its muscles immediately contract and produce that action, so long as their nerves are connected through the medium of the spinal marrow with the brain; but if these nerves be separated from the spinal cord, although the brain has still the power to will the motion, yet its influence upon the muscles ceases, and the limb remains incapable of motion from vital stimuli, although mechanical or chemical stimuli acting upon the divided nerve will yet produce an involuntary action of the muscles: this latter phenomenon only lasts, however, for a short time after the nerve has been separated from the centre of the nervous system. The passions seem to produce an immediate effect upon all the muscles of the body, both of the voluntary and involuntary class.

Of the mechanical stimuli, their application, even from the slightest touch to the greatest degree of violence, will produce the contraction of muscle, whether it be applied to

the brain, spinal marrow, nerve passing into a muscle, or to the very muscle itself. Indeed, mechanical stimulants sometimes rouse into action a distant set of muscles which seem to have no direct communication; as a crumb of bread in the glottis produces violent contraction of the muscles of expiration. The natural stimuli to the involuntary muscles seem to be of this class, as the flow of blood into the cavities of the heart, and the accumulation of the contents of the viscera produce contraction of their muscles; but this may perhaps be partly attributable to chemical agency.

The chemical stimuli, as alcohol, acid, alkalies, &c., produce an immediate action on the muscular system, and more especially on the involuntary muscles; but it is perhaps doubtful, whether they really produce it from chemical or mechanical influence. Galvanism and electricity, which produce no apparent physical change in a muscle, will yet cause its violent contraction; it is difficult, therefore, to know which class of stimulants to place them with; no change, either mechanical or chemical, can be traced: they have, therefore, by some physiologists been ranked amongst the vital stimuli, considering, perhaps, their effect as more closely allied to the natural impulse communicated to the muscular system through the brain and nerves; for the contraction of muscles, produced by high degrees of nervous affections, is very similar to the contractions produced by galvanism or electricity.

It is no less true than wonderful that particular muscles, and even particular fibres of the same organ, should be differently affected by different stimuli; thus, certain substances produce the natural action of the stomach and the bowels, while others will produce vomiting and purging; and yet no difference can be perceived in the organization or chemical properties of the fibres themselves. There seems, however, to be a contractile power in muscle which is independent of any influence from the nervous system, as indicated by the contraction of a paralysed muscle, or the

involuntary action of a voluntary muscle, as in cramp and spasm: this inherent property has been termed by Haller the *vis insita,* in contradistinction to the *vis nervosa,* which enables it to receive the impressions made upon it through the nerves; the one, in fact, being voluntary, while the other is involuntary. May not the rigidity which is observed to take place in muscle immediately after death be attributable to an exertion of the vis insita? Such rigidity, however, we know is in a short time succeeded by permanent relaxation.

The volition of the mind, which acts through the medium of the nerves, produces its influence only on a certain class of muscles, which are called, therefore, the voluntary muscles. The excitement caused by the passions of the mind is also transmitted through the medium of the nerves, but is capable of extending its influence to every class of muscle; as is proved by its effects upon the heart, stomach, bowels, &c., as well as the voluntary muscles. A stimulus applied to the skin, to the mucous membranes, to the internal membrane of the heart, or to the serous membranes, has also the effect of producing contraction of the muscles. And, lastly, if muscular fibre itself be irritated, it contracts; but yet it is doubtful if the stimulus does not act through the medium of the nerves, from the circumstance, that when only a part of a muscle has been irritated, the whole muscle is observed to contract.

The duration of contraction is longer when any voluntary muscle is acted upon by its natural stimulus, namely, the will, than if it be made to contract by any mechanical or chemical stimulus. Indeed, this may be said of all the muscles, that their natural stimuli influence them for a longer period than any artificial excitement.

The general effect produced by the contraction of the muscles in the living body, consists either in producing or preventing motion, both in the solid and fluid parts of the organismus, and frequently of the whole body. The various modes in which they contract may be reduced to the three following:—

First.—Both the extremities of the fibres of the contracting muscle may remain fixed during the time of contraction; as is exemplified in the action of the diaphragm, of the muscles of the abdomen, and of the buccinator.

Secondly.—Both their extremities may be in motion, as happens during the contraction of all the sphincter muscles, as all those of the stomach, and intestines. And,

Thirdly.—One extremity of the acting muscle may be fixed while the other is moveable; this state may be best observed in the contraction of most of the voluntary muscles.

The contraction of a muscle then, on the application of stimuli, sufficiently attests its irritability; but it has been supposed by some, that its irritability is not proved merely by its ordinary contraction under such circumstances, but that it is also manifested in the change which certain muscles are observed to undergo after having been mechanically put upon the stretch, as seen in the extension of the abdominal muscles during uterine gestation, and ascites. It is right, however, to remark, that this phenomenon has received from some physiologists a different explanation; for, regarding the entire length of a muscle as made up of distinct ultimate fibres, united by interposed cellular tissue, they suppose the mechanically increased length of the muscle to result, not from any inherent property of the muscular fibre itself, but from the physical extension of the cellular tissue.

The power of contraction of muscular fibre, upon the application of a stimulus, continues for some time after death; but the precise period for which this capability of being excited lasts is not the same in all muscles; and it also depends upon the state of the individual's health just prior to death, as well as on the cause of dissolution: for it is found that very sudden death, such as that by lightning, removes at once all contractile power in the muscular system. The following order has been of late assumed, as being that according to which the extinction of muscular irritability takes place successively after decapitation. First, the aortic ventricles;

second, the intestines and the stomach; third, the muscles of the urinary organs; fourth, the pulmonary ventricles; fifth, the œsophagus; sixth, the iris; and seventh, the external muscles. The same order of succession takes place when the muscles are detached from the body.

From what has been said of the inherent contractibility of muscle, it is evident that their *use* must be either to move the body from place to place, or to change the form and alter the capacity of certain parts of the body, according to the several functions of those parts. This leads us to distinguish into two principal classes the various combinations of the muscular fibre. Muscles generally may be called the active agents of locomotion, as we are in the habit of terming the skeleton the passive agent; but the alteration in the form and capacity of certain parts of the body, acted upon by the muscular contraction, may be either under the control of the will, or wholly independent of the direction of volition; and therefore we are in the habit of dividing the muscles, according to their uses, into voluntary and involuntary. The former class comprehends all the muscles which are attached to the extremities, and to such parts as are moved by the influence of the will, and are said therefore to belong to *animal life;* while the involuntary muscles, which are stimulated to action by distention from their natural contents, and which form the parietes of hollow organs generally contained within one of these great cavities, maintain functions, the constant performance of which are essential to existence; and hence they are said to be the vital organs: such muscles, therefore, we find influencing the circulation of the blood, and the functions of the stomach and bowels. The action of these muscles seems to depend upon the influence of their peculiar nerves, though not upon the brain; for in brainless monsters the action of the heart and intestines continues the same. But yet it seems that the action of such muscles is, at any rate, influenced by the brain, as is proved by the effects of joy, rage and grief upon the organs of

vegetative life; so that it may be justly concluded, that the involuntary functions depend upon the nerves, but are influenced also by the brain.

There is yet a third class of muscles, which seems to form a link between the other two; they are termed the mixed muscles: the best example of which we have in the muscles of respiration, destined to be always in action from the constant necessity of that function, which is usually performed twenty times in a minute; but yet a person has the power of rendering respiration quicker or slower at will: and, further, in difficult breathing, many of the muscles destined under common circumstances to move the upper extremities, exert an involuntary power to assist the respiratory organs.

There are, indeed, such distinguishing marks, both in the construction and function of these three classes of muscles, that it becomes necessary separately to describe them, so that they may be divided by the anatomist, as well as by the physiologist, into distinct classes.

The Involuntary Muscles.

The involuntary, or, as sometimes termed, the internal muscles, are those which belong to vegetative life: they bear separately no particular names, but are denominated according to the organ of which they each form a part.

To this class belong the muscles of the heart, of the alimentary canal, of the uterus, of the urinary organs; and probably also the fibrous structure of the iris and trachea, which some have regarded as muscular and referred to this class, but it has yet to be proved that these fibres are actually muscular.

The muscles of this class are deeply seated, and may be easily distinguished from the voluntary muscles. They are much less bulky, and form hollow cylinders, the internal surface of which is lined by a mucus membrane. Their fibres are of a greyish yellow colour, excepting those of the heart, which are of a deep red; and, unlike the voluntary muscles, they are not furnished with tendinous attachments:

no trace of which structure is to be found excepting in the heart. The directions of fibres in this class are various, being disposed in layers, which are obliquely intersecting each other, so as to produce by their contraction a diminished capacity of the cavity of which they form the parietes. The involuntary muscles are not furnished with antagonists; but when they contract by tending to diminish the size of the cylinders which they form, they are pressed against the substances contained within them, which may, indeed, be said in some measure to antagonize them.

The involuntary muscles sometimes, by their contraction, produce a simultaneous action of the external and mixed class of muscles, which thus assist them in the performance of their functions, as in sneezing, coughing, and vomiting.

The blood-vessels of this class of muscles are said to be very numerous; but it does not seem that they are distributing themselves so much to the muscles as to their lining membrane; and therefore it is doubtful if it be right to describe them according to the usual mode, as receiving more blood than the class of voluntary muscles.

The involuntary muscles derive their nerves principally from the sympathetic, but also a few from the nerves of the spinal marrow; and these nerves are stimulated, or, in other words, the irritability of these muscles is manifested by some local stimulus acting upon their fibres through the medium of the membrane which covers them; so that their action may be said to be independent of the will, although it must at the same time be granted, that strong emotions of the mind do produce an involuntary influence on their action. It would appear that the involuntary muscles are more excitable, and are sooner put into action upon the application of a stimulus, than the voluntary ones; thus it is not uncommon to find the whole intestinal canal excited by the introduction of a foreign body, as a suppository into the rectum; and this action is said to be produced by sympathy; which is, in fact, a term evincing their extreme excitability. The colour of these muscles, the curved direction of their fibres,

the variety of their form depending upon the organs to which they are attached, and their want of connection with tendons, are, as I have said, the principal distinguishing marks of the internal or involuntary muscles.

The *mixed class of muscles* are those which, both in structure and function, are intermediate to the voluntary and involuntary; their distinguishing characters I shall describe before those of the voluntary class, as the latter are more especially the object of consideration in viewing the muscular system.

This intermediate class of muscles are named the mixed, in consequence of the voluntary power we possess over them to modify their action; although, at the same time, we cannot by any effect of the will entirely stop the performance of their function for any length of time. The diaphragm, and all the muscles of respiration, are included in this class, as we are enabled to use them quickly or slowly at will, although we cannot by the same effort cease to respire for any length of time; habit, however, renders persons capable of suspending this action for a considerable period, as may be observed in divers. The sphincter muscles may be considered as belonging to this class, for they are not constantly under the dominion of the will.

These muscles differ in structure from the involuntary, in having tendinous attachments, and also in being of a red colour; many, however, resemble them in having their inner surfaces covered by a membrane, and in partly receiving their nerves from the sympathetic.

The irritability of these muscles may be considered as somewhat greater than that of the voluntary, and less than that of involuntary muscles; whilst their power of contraction is also intermediate.

The Voluntary Muscles.

These muscles, which belong to the animal functions, are attached to the bones, and constitute the active power which put those levers in motion. These muscles are firm and

solid, and constitute therefore a very considerable portion of the bulk of the human body; they are also of a florid red colour, composed of fasciculi which run parallel to each other, and are usually attached at each extremity to tendons, or some other parts of the fibrous texture, through the medium of which they become connected with the bones. There are but few exceptions in the voluntary muscles to their being found in pairs: the diaphragm and sphincters are considered as these exceptions; but these are rather to be classed amongst the mixed muscles. The size of the voluntary muscles varies considerably; some being of very large, while others are of the smallest dimensions: and their figure also offers numerous varieties; some being very *long,* as those of the extremities; others *broad,* as those which cover the cavities; while those which are attached to the irregular bones, are *short* muscles.

The motions which take place in the human body, as produced by the action of the voluntary muscles, are flexion, extension, lateral inclination, rotations toward opposite directions, abduction, adduction, elevation, and depression; and from the performance of these actions have several of the muscles been named: hence the term flexors, extensors, abductors, adductors, elevators, &c. They sometimes also derive their name from the direction of their fibres, as the obliqui abdominis; from the number of their origins, as the biceps and triceps; from their figure, as the trapezius; from their formation, as including two distinct fleshy portions divided by an intervening tendon, as the digastrici; from their situation and comparative size, as the pectoralis major and minor; and also from their attachment, as the sterno cleido mastoideus, genio hyo glossus, &c.

A classification of the muscles of volition has also been attempted, by dividing them into those belonging to the skeleton, to the larynx, to the organs of the senses, and those of the skin: and if those of the skeleton be subdivided in the manner of the bones into the long, the flat, and the short, the arrangement will be found, perhaps of all others,

the best for facilitating their description; those of the larynx and of the senses being treated with the particular description of those parts.

On considering the muscles of the skeleton then, those which are attached to the extremities are of an elongated form; while those of the trunk are broad, and cover the cavities of the skeleton, by which they assist in forming the abdomen, thorax and cranium.

The long muscles attached to the extremities are more or less cylindrical, and have a considerable length of tendon attached to them, even sometimes longer than the muscle itself. When the long muscles extend over the long bones of the extremities, they are generally divided into two layers, of which the external are the longer; as, for instance, may be observed on the arm, the biceps being much longer than the brachialis internus. Muscles of this kind frequently divide into several tendons for their insertion.

The broad muscles are generally thin, and, as I have said, are usually assisting in forming the parietes of the cavities of the body; but beside which, they contribute to the function of the viscera, which they enclose, so that many of them are more justly to be considered as belonging to the mixed, than either to the voluntary or involuntary class of muscles. They generally maintain the same degree of thickness throughout their extent, and frequently arise by mixed digitations, by means of which they attach themselves to many parts. These muscles sometimes cover the long ones, as may be observed on the back: there are some of them which, although from their attenuated form and manner of attachment, resemble this class, yet have their breadth so little beyond their length, that they appear to form a link between this class and that of the long muscles.

The short muscles are generally thick in proportion to their length and breadth, so that indeed their threefold dimensions are nearly equal; they are usually of a square form; they are the strongest of all the muscles, as they

contain, in proportion to their size, the most fibres; and they are therefore found in situations where great power and quickness, rather than great extent of motion, is required; as, for instance, in the articulation of the lower jaw with the temporal bones, in the hand, foot, &c.

The middle, or most fleshy part of the muscle, is called the *belly;* the superior part, or that which forms the origin or more fixed point, is termed the *head;* whilst the opposite extreme, or more moveable point of a muscle, is called the *tail.*

In ordinary circumstances, the contraction of a muscle takes place in such a manner as to draw the tail, or point of insertion of the muscle, towards the head, or point of origin; but this is not universal.

The external form of the muscles varies considerably, as well as the direction of their fibres, so as to lead to distinguishing terms of simple, compound, penniform, semipenniform muscles, &c. A muscle is termed simple, when it is composed of a single head and terminating by one tail into a single fixed point; so that the course of all its fibres is exactly the same as the course of the muscle itself, and consequently its force is exercised in the line of its direction; this is the most simple arrangement. Other muscles divide at one of their extremities into several parts, and are called therefore compound muscles; this division may take place at either their origin or insertion, as may be observed in the muscles of the abdomen, and of the toes and fingers; in the former case, the contraction of the whole muscle would give to the moveable part a motion in the mean direction of all the forces employed; while in the latter, the contraction of the single belly would put several parts in motion at the same time. It should be observed, however, that some of the simple muscles seem to form an intermediate link between the simple and compound ones, as the deltoid and subscapular muscles.

The penniform muscles are those which are composed of two sets of fibres, passing to be inserted at a greater or

less angle into a single central tendon; the rectus femoris offers the best example of this class of muscles: and when the fibres are inserted into one side of a tendon only in a like manner, it then is termed a semi-penniform muscle. The peculiar use of this oblique attachment of muscular fibres to their tendons, will be mentioned when speaking of the mechanism of muscle.

Mechanism of Muscular Motion.

As regards the laws according to which the various muscular motions are effected, it is first to be considered, that the bones are merely the passive organs, and that the muscles may be said to act upon them according to the law of mechanics; the muscles acting upon the bones, and the weight to be raised upon the principle of the lever. But in the investigation of this mechanical law we shall find one great difference in the application of it to the animal frame, when compared with any mechanical instrument; for in the former at first view it seems that the muscular power is not applied to the greatest advantage, but on the contrary, that the force employed is much greater than seems necessary for the weight to be moved; while in machines it is always the object to employ no greater force than is equivalent to the weight: but we shall find, in carrying further this analogy, that there are several advantages gained by this apparent imperfection, which more than compensate for the expenditure of power.

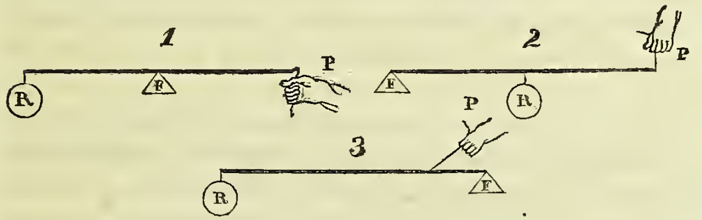
That the mechanical disadvantages at which the muscles act, as far at least as refers to the force they are obliged to use, from the peculiar manner in which they are inserted into bone, may be better understood, I shall first describe the three kinds of lever which are mentioned in mechanics.

The first, and that most commonly used for all mechanical purposes, is, that in which the power is at one end, the fulcrum or fixed point in the centre, and the weight or resistance at the other end; we employ this lever in poking

the fire, and other common purposes in which we call the lever in aid; and yet, of the three kinds, this is the least frequently employed in the action of muscles.

The second kind has the resistance in the centre, the power at one end, and the fulcrum at the other.

The third kind is that in which the power is in the centre, the resistance or weight at one end, and the fulcrum at the other. These levers, and their mode of action, may be more easily understood by the following diagram:—



The third kind is the one most used during muscular action in the body, which, according to the laws of mechanics, is the most disadvantageous; but the advantages which are gained by it will afterwards be mentioned in some of the motions of the muscles: however, all three of the levers are employed; for instance, when the head is moved on the first cervical vertebra, the fulcrum is placed between the power and resistance, as in the first lever: when the weight of the body is raised by standing on tip-toes, then the resistance is placed between the fulcrum and the power: and, as the third, in raising a weight in the palm of the hand, by bending the elbow, the power is situated between the fulcrum and the resistance.

This usual application of the lever, which occasions a necessary loss of power to the muscles, is not the only disadvantageous circumstance under which the muscles act, according to strictly mechanical principles; but there are other causes which should also be pointed out:—

First.—That the efforts of some of the muscles are divided, partly by acting upon the bone from which they

arise, as well as upon the bone into which they are inserted, both being moveable, producing therefore a loss of power.

Secondly.—From the insertion of many of the muscles being nearer to the fulcrum than to the resistance, which induces the necessity for greater force, and precisely in the proportion as the insertion of the muscle is near to the fulcrum and distant from the weight.

Thirdly.—The oblique insertion of some of the muscles, both as regards their attachment to bone and to tendon, produces a disadvantage in their action.

Fourthly.—The resistance which muscles have to overcome from antagonist muscles, as well as to oppose the weight of the body to be moved. And,

Fifthly.—There is a power of muscles to be expended in overcoming the resistance offered to them, owing to the friction of the surrounding parts.

Having now contemplated the disadvantages in application of the force of muscles upon mechanical principles, it is proper that we should point out some circumstances which are evidently favourable to the purpose of assisting muscular action. In the examples already given of the loss of power, it will be easily shewn, that there are equivalent advantages gained by each adjustment. One of the most unfavourable circumstances to the action of the muscles which is mentioned, is, its insertion being nearer to the fulcrum than to the resistance; which, in the instance of the flexion of the fore arm, is calculated as a loss of fifteen parts out of twenty of the force employed. But it seems a law of the animal economy, that muscular power should be sacrificed for convenience; for if this muscle had been so placed as to require the least power to move the resistance, the muscle would have been placed on the fore arm, and the tendon attached above; but this would have destroyed the symmetry of the limb, and produced a general inconvenience which would have more than counterbalanced the advantage derived from economizing muscular power. And, further, by this arrangement a positive ad-

vantage is gained by the velocity with which the point of resistance is thus made to move; so that the advantage may be said to arise from gaining in velocity what is lost in the expenditure of power.

The obliquity of the direction of the muscular fibres also offers advantages during their action; for although by this arrangement power is lost in exact proportion to the deviation of the muscular fibre from the direction of the moving point, still great benefit is derived from the saving of the quantity of contraction, as well as from the additional quantity of muscular fibre which is thus accumulated; for diminishing the necessity of contraction of muscle is a point of great importance, as the fatigue of muscle seems to depend upon the extent of contraction.

Although most muscles have to use an additional force to overcome the action of their antagonists, and thus render an expenditure of power necessary from the composition of forces; still it is clear, that infinite variety and exactness of muscular motion is accomplished by this arrangement, as the moving body can range in every given space between the direct action of the various muscles, and therefore fewer muscles are required. In every example where muscular power is sacrificed, it will be found that some important benefit is derived; and that the symmetry of the body is preserved in such a manner as no other arrangement of the muscular system could admit.

The effects produced by muscular contraction are, the determining both the altitude and the motions of the body in acting upon the skeleton, to move the organs of the senses, to produce modifications of the voice, and to contribute in a greater or less degree to the performance of the vegetative functions. To produce these effects, and particularly when we reflect on the extent of exertion employed, the mind is led to comprehend the wonderful power with which this system is invested. Thus, according to Borelli, the power of the flexor muscles of the thumb is alone equal to four thousand pounds weight: nevertheless, from the dis-

advantageous circumstances in reference to the attachments of muscles, as already described, they cannot exhibit any thing like that power in raising a weight. The velocity of muscular contraction is equally wonderful: the rapidity of speech, the quickness of motion of the fingers, are all illustrations of the extent of this power.

On Tendons.

In the general description of the muscular system, the tendinous attachment of the muscles have been mentioned as answering the purpose of cords to transmit the force of the muscles—the active organs of motion to the moveable bones; and this important function imposes the necessity of considering their structure, and of pointing out their peculiar properties. Tendons belong to the fibrous tissue which presents itself in the human organismus under this form, as well as that of ligaments, both being of the same tissue, and only so far differing in use, that the ligaments connect bone with bone, while tendons attach muscles to bone. The tendons are commonly found to be situated at both extremities of a muscle; not that they really commence from these extremities; for, by close examination, they may be traced to a condensation of the cellular membrane of the muscle to which they belong, proceeding from the internal cellular covering of all the fibres, as well as from the general investing aponeurosis; and then, forming a thickened rounded cord, passes to be inserted into bone, and, in most cases, by expanding and losing itself in the periosteum. The proportion between the muscles and their tendons is variable; but usually they are thinner than the muscles to which they are connected. The tendons are not always found at the extremities of a muscle, but sometimes in its centre, producing a digastric muscle; and in other instances there are several tendinous intersections, as in some of the muscles of the abdomen: thus dividing the muscles into several parts, and furnishing so many fixed points, towards which the muscular fibres contract and are

directed. Tendons are not attached to the involuntary muscles excepting in the heart, where we find the fleshy columns attached by tendon to the valves; neither are the sphincter muscles furnished with tendinous attachments.

Tendons sometimes divide into several ramifications to be attached to separate bones, as the tendons passing from the muscles of the toes and fingers; and in other instances, we find two or more tendons uniting to form one, as the junction of the gastrocnemii soleus and plantaris in forming the tendo Achillis.

The tendons do not usually change the direction of muscular motion, but this change does however sometimes occur from the projection of the apophyses of the bones, as may be observed in the malleoli reflecting the tendons of the flexors of the foot and toes nearly to a right angle; and, indeed, the tendons themselves sometimes send off processes to be connected with other parts out of the direction of their insertion into bone, as the tendon of the biceps both of the arm and leg; the former to produce the fascia of the fore arm, and the latter to be connected with the posterior ligament of the knee-joint. The tendons are furnished with cellular sheaths, which resemble in their use the periosteum of bone and the perichondrium of ligament; and they are in some situations tied down by annular portions of ligament as they pass over bone; in which case these envelopes are furnished with a synovial membrane to protect them from injury by friction: besides this, where tendons pass close to bone, they are frequently converted into a fibro-cartilaginous tissue, and even in some instances into bone itself, to render them better able to bear friction and pressure. The tendons are enclosed in a sheath of loose cellular membrane, which secretes a fluid to lubricate their surfaces, and facilitate their motion; into this membrane small blood-vessels may be traced conveying red blood, but they cannot be demonstrated passing into the tendons themselves; a circumstance which depends partly upon their diminutive size, and partly because they circulate only the transparent constituents of the blood.

Tendon, from its physical properties, as its extensibility and great strength, is in the best possible manner adapted to its peculiar function of communicating the force of muscle to the bones; and also from its comparative little vitality, it is but rarely affected by disease, although it possesses enough of vital principle to be able to repair itself when ruptured, of which we have frequent examples in rupture of the tendo Achillis. In this case, the agglutination does not at first enjoy all the properties of tendon; but in the course of time, when influenced by the action of the muscles, it becomes hardened as the original tendon. Mr. Charles Bell has likened the construction of tendon to the most perfect mode of rope-making; and observed, that it is hatchelled, straided and twisted in the same manner: and superadded to this mechanism, it is influenced by a vital principle, which renders it superior both in strength and adjustment, as well as capable of maintaining its own growth and perfection.

Practical Remarks.

The diseases of tendons are but few, as indeed might be supposed from their structure and essential physical properties—extensibility and cohesion; which well qualifies them to transmit the action of the muscles to the passive organs of motion—the bones; but it is found that they are susceptible of injury, although by some it has been believed that they do not possess nerves and vessels: a strain however, produced by an inordinate action of a muscle upon a tendon, will at once prove the existence of nerves, which are sensible to the undue application of their function; although, when exposed, they are not pained by cutting or rubbing: a mechanical injury to which, in their naturally covered situation, they are not liable: hence the physiologist must infer, that nerves are only susceptible of painful sensation and injury from such causes as, in a less degree, are the natural stimuli to the functions which they are destined to perform. Puncture and laceration however produce in them swelling and agglutination to sursounding parts, which requires a length of time to reduce. The cellular sheaths of tendons are liable to inflammation and to its effects; and if going on to suppuration, the tendons are frequently left bare, but yet remain uninjured.

The Synovial Capsules of Tendons.

These capsules are found connected with the tendons of the muscles wherever they are exposed to friction, and whatever may be the structure over which they pass; hence they are placed between tendon and bone, tendon and ligament, between two tendons, and further, between tendon and cartilage. The number of these membranes, which are termed bursæ mucosæ, is said to amount to upwards of one hundred and forty. These bursæ are of different sizes in different parts of the body, and are said to be larger in children than in adults: their figure also varies; they sometimes form round vesicles, connected on one side with the tendon whose motion they are destined to facilitate, and on the other with the structure over which the tendon glides; at other times they form lengthened vaginal sheaths, lining canals, through which tendons pass, and, proceeding from one large synovial capsule, divide into as many sheaths as there are tendons and canals. This mode of arrangement may be observed at the wrist and ancle-joints, for the tendons of the toes and fingers. The superior oblique muscle of the eye, and the tensor palati, offer another variety of bursa mucosa facilitating the motion of tendons over cartilage. These bursæ resemble very much the synovial capsules of joints, and bear the same resemblance to the large serous cavities, in producing a closed sac without any external opening; their organization seems to be similar to the rest of the serous tissue, as if formed of condensed cellular membranes; their blood-vessels may be demonstrated, although absorbents and nerves cannot be traced to them. The secretion from these capsules of the tendons is viscid, and in its physical properties very much resembles the white of an egg: its chemical analysis has the same results as that of the synovia of the articular capsules. There are also within these bursæ small masses of fat, with fringes, prolonging themselves into the cavity, but covered by the membrane of the bursa; and upon which the small

ramifications of the arteries may be traced. The synovial capsules of tendons being, in organization and function similar to the articular capsules, they are liable to the same morbid changes, both from age and disease. In old age they become firmer, less flexible, and secrete less synovia than during youth: hence the stiffness of the motions of the fingers and joints of old people. The successive development of these membranes in the human body is not well understood: according to some, they exist in a greater number during infancy; and become enlarged, and run into one another, in old age.

Practical Remarks.

The synovial capsules of the tendons are liable to inflammation; and although perhaps less so than the serous membranes lining the large cavities, yet, as in them, inflammation encreases and alters their natural secretion, producing frequently an accumulation similar to hydrops articuli, but which in this situation is termed ganglion. The bursa between the ligamentum patellæ and tibia, and the synovial capsules connected with the tendons about the wrist, are particularly liable to this disease. These tumours contain a viscid fluid of a yellowish red colour, consisting of a considerable quantity of albumen. The cause of their formation is generally unknown, although at times it may be traced to pressure: hence the frequent occurrence of ganglion of the bursa below the knee of house-maids. On the increase of the synovial fluid and consequent enlargement of the bursa interfering with the motions of the tendon, it is the object of the surgeon to promote the absorption of the fluid; and in many cases this object may be gained by blisters and pressure; but in others, where the synovial capsule is very much thickened, and the fluid itself inspissated, these local means will not avail, and puncture or setons are recommended: but as far however as my experience leads me to judge, I should be cautious with this mode of procedure, as I have several times seen the very worst effects follow this treatment; and I should always reprobate it when the ganglion is situated in the neighbourhood of a large joint. I have frequently known the dispersion of the fluid, by bursting the sac with a sharp blow, produce at once a radical cure.

Chronic inflammation of the bursæ does sometimes produce ulceration: sometimes the formation of cartilaginous bodies within the sac—a disease very similar to the formation of loose cartilage within the

articular synovial capsules: and further, a long continued inflammation does sometimes produce a secretion of a pulpy nature, resembling pieces of pear, which seem to be imperfectly organized adhesive matter, filling up the synovial sac. In such cases the constitution is usually impaired, and requires, therefore, a strict medical, as well as local treatment.

LECTURE XIII.

DESCRIPTIVE ANATOMY OF MUSCLES.

Introductory Remarks.

In the arrangement or classification of the muscles, the object is in the clearest manner to direct the student to a thorough knowledge of this system, both anatomically and physiologically; but in this a considerable difficulty arises from the impossibility of arranging them so as equally to facilitate the mode of investigating them by dissection, and classifying them according to their uses. It has already been shewn that the muscular system, from the peculiar power it has of contraction, serves to give motion to every part to which it is attached: physiologically, therefore, muscles might be arranged according to their respective uses: as those which act especially upon the osseous system, those which move soft parts, and those, the object of which is to assist other organs in the performance of their respective functions. Now, to adhere to such a description of the muscular system, would be to assume what cannot by any means be conceded—that each muscle, or set of muscles, performs a single and exclusive function; and that every individual purpose is effected by a particular muscle, or set of muscles. But although such assumptions prove applicable to machinery, formed by ingenuity of man, they are found altogether at variance with the wisdom and power displayed in the construction of the living human body. No such singleness of purpose is here to be found; but, on the contrary, by an equally wonderful and beautiful contrivance, an individual muscle, or a partial set of muscles, is made subservient to a variety of important objects: thus we have

the muscles attached to the bones of the chest subservient at once to the act of respiration, to the expulsion of the fæces, and to the motions of the body upon the pelvis; whilst innumerable instances, equally striking, might be adduced to illustrate the same principle. Even physiologically, therefore, such an arrangement as that I have just alluded to, would prove extremely inconvenient and imperfect; whilst, to the student engaged in actual dissection, it would not only be perfectly useless, but tend to mislead and complicate his study.

Another plan, perhaps better calculated to assist the pupil in acquiring and retaining a knowledge of the muscular system, is, to specify numerically the whole of the muscles of a particular part or region of the body, with a corresponding numerical subdivision, according either to their origins and insertions, or to their individual and combined uses. Such a plan has long appeared to me to be of the greatest use in teaching anatomy; and, indeed, I may conscientiously say, that the advantages in its adoption in my lectures, have been felt and frequently acknowledged by those most interested in the result.

An objection, nevertheless, immediately presents itself to such a plan, in its inapplicability to the purposes of practical anatomy; for, to the dissector, the principal object is, to be prepared to recognize the various parts and structure brought into view as he proceeds in his dissection: an object, indeed, altogether indispensible. Such a plan, accordingly, has been occasionally adopted: the various parts, layer after layer, being described as they presented themselves in the progress of dissection; but it is a plan which is not very easy or very scientific to adhere strictly to, either in lecturing or in an elementary treatise, without producing great confusion and embarrassment, inasmuch as both the proper and compound action, as well as the individual uses of muscles, must yield to mere mechanical position. Finding, therefore, all these plans themselves more or less imperfect, it will be my endeavour so to avail myself of, and combine the advantages of

each, as to render this elementary work, if possible, useful alike to the reading student and to the practical anatomist. It is my intention, with this view, in the first place to specify numerically the muscles of particular parts and regions of the body, with corresponding numerical subdivisions, according to their origins and insertions, as well as to their respective and combined uses: thus, for instance, in the description of the muscles of the upper extremity, it may be first observed, that there are fifty-one muscles which give motion to the bones of the arm; but as these bones form numerous joints, the muscles must secondly be divided in such a manner as to specify what joints each set are destined to move; so that, in the second place, they may be subdivided into the seven muscles connecting the scapula to the trunk, the nine muscles of the shoulder-joint, the four muscles of the elbow, the four muscles of the radio-ulnar articulations, the six muscles of the wrist-joint, the five muscles common to the fingers, the eight muscles proper to the thumb, two of the fore finger, three muscles of the little finger, and one common to the skin and fascia of the palm of the hand; by this arrangement both the muscle and uses of each set of muscles is understood; but yet, has to be learnt, the origin and insertion of each muscle, and their relative position with respect to each other: a knowledge which can only be acquired by dissection. Now, to facilitate this mode of investigation by description, a third and further division must be adopted to lead the student progressively on to the desired object: thus for instance, in dissecting the muscles of the scapula, his task is rendered easier by knowing that there are two muscles situated above the scapula to raise that bone, three placed behind to draw it backwards, and two in front and on its inner side to draw it forwards and towards the trunk. By prosecuting the dissection of the muscles according to this classification, the relative position of the muscles is necessarily learnt as well as their attachment; and the dissector learns that all these muscles arise from the bones of the trunk, and are inserted

into the scapula. There is now only left for him to study the direction of the fibres of each muscle; and their individual action is rendered apparent by the knowledge, that a muscle, when contracting, must of necessity draw the more moveable point towards the more fixed one, in a direction precisely opposite to that of the fibres of the muscle in action. The muscles of the shoulder and elbow-joints admit of equal facility of dissection according to their uses, as they are not concealed by the muscles of any other articulation; but those of the radio-ulnar joints and of the wrist and the fingers, are more complicated in consequence of their being so connected with each other as scarcely to admit of their being dissected in the order of the joints to which they belong, but require to be arranged in layers as they present themselves to view in the progress of their dissection: thus it may be premised, that the muscles situated between the radius and ulna, both anteriorly and posteriorly, belong in part to the radio-ulnar, wrist, and articulations of the fingers. Those situated in front are eight in number: they principally arise from the internal condyle of the humerus, and are disposed in two layers, five being placed superficially, and three of them deeply seated: and in the same manner the eleven muscles filling up the space between the radius and ulna behind, are forming two layers—six of them being superficial, whilst five are deeply seated: the muscles in the superficial layer principally arise from the external condyle of the os humeri. Muscles situated on the hand are also placed so as to preclude the possibility of dissecting them so as to expose them in order, according to their uses: but they may be readily understood by the following classification: the first muscle seen upon removing the skin from the palm of the hand is the palmaris brevis—a muscle proper to the skin and fascia of the hand; and on removing this muscle, with the palmar fascia on the outer side of the hand, the muscles proper to the thumb are exposed; and on the inner side, those of the little finger; while in the centre, there are superficially placed, the tendons of the flexor sublimis

and profundus digitorum, with the lumbricales; and deeply seated, the interossei. On the back of the hand the muscles are less numerous and complicated; being only the extensors common to the fingers, with the interossei.

I have, in this introduction to the description of the muscles, mentioned those of the upper extremity merely to point out the difficulty of their classification and the mode I wish to adopt to facilitate their arrangement; and shall now proceed, as is usual in ours, as in most schools, to the muscles of the abdomen.

The Abdominal Muscles.

The exterior muscles of the abdomen belong to that class denominated in the physiological classification, flat or broad muscles; being composed of parallel fibres terminating in thin expanded aponeurosis, and situated in those parts of the frame where a great extent of surface is required to afford muscular parietes to cavities, for sustaining and assisting the function of the important organs which they contain.

They consist of five pairs: the obliqui, externi et interni, the transversales, the recti, and pyramidales. The obliqui transversales and recti, are named from the direction of their fibres; while the pyramidales have derived their name from their form.

Previous to the particular description of these muscles, it is necessary to make some observations on the method of exposing them in the course of their fibres, in order that the dissection may be clearly and dexterously performed. First, an incision should be made from the cartilago ensiformis to the symphisis pubis; the second incision should divide the integuments in an oblique direction upwards and outwards, beginning from the umbilicus, and extending over the ribs as high as the sixth; and the third incision is then to be made downwards and outwards, from the umbilicus to the crista of the ileum. On raising the skin from the fibres of the muscle it is to be observed, that a condensed

cellular tissue is also raised with it, which is situated on the whole anterior surface of the abdomen, between the skin and the muscles, being sufficiently thick and demonstrable to derive the name of *fascia superficialis*.

This subcutaneous aponeurotic membrane covers the anterior and lateral parities of the abdomen; it is dense and strong inferiorly, and is continued upon the thigh laterally; while in the middle inferior part of the abdomen it passes downwards, so as to give a covering to the organs of generation; passing over the external ring, and proceeding from the scrotum in the male, and the labia pudendi of the female, it becomes the superficial fascia of the perineum: superiorly it passes upwards upon the thorax, and is continuous with the cellular membrane covering the platisma myoides muscle; while, laterally, it becomes more and more attenuated, until it is lost in assuming the appearance of common cellular membrane. This fibro-cellular membrane is somewhat elastic, and strengthens the muscular parietes of the abdomen; it becomes an object of interest in pathological as well as in anatomical considerations, as forming one of the coverings in herniæ, being sometimes so thickened as to present a very dense and important structure. This fascia being cleanly dissected from the muscular and tendinous parietes of the abdomen, the external abdominal oblique muscles are seen forming the lateral regions; while a tendinous structure occupies the central and lower part of the abdomen, producing several white tendinous lineæ, rendered more opàque than at other parts by the junction of the tendinous insertion of the abdominal muscles.

The *linea alba* is situated in the middle line, and extends from the sternum to the pubes; it is formed by the union and interlacement of the tendinous expansions of the musculi obliqui and transversales. In the centre of this line is situated the umbilicus, which is a cicatrix filling up an opening which, in the fœtus, gives passage to the parts producing the umbilical cord; the linea alba is broadest at this part, above it is thin and semi-transparent, below it is dense and opaque.

On either side of the linea alba, and from three to four inches distant from it, is a crescentic white line, having its convexity turned outwards; it reaches from the junction of the cartilage of the eighth with the seventh rib to the upper part of the pubes, opposite to the spinous process of that bone, and is termed the *linea semilunaris.* This line is formed by the junction of the tendons of all the flat muscles of the abdomen; and, indeed, is the point where these muscles become tendinous. There are also lineæ to be observed which pass transversely from the linea alba to the lineæ semilunares, which are termed the *lineæ transversales,* and usually, though not always, are found in the following situations: the first one is generally opposite the cartilage of the last true rib; another midway between this and the umbilicus; a third opposite to the umbilicus; and, lastly, midway between the umbilicus and the pubes a fourth is found, but this usually is but half the length of the others. This tendinous expansion forms a complete aponeurotic boundary to the lower part of the abdomen, reaching across from the one anterior superior spinous process of the ileum to the other, and connected with the pubes in the middle line in such a manner as to produce a free edge on each side of the pubes, which is termed Poupart's ligament; and which will be better understood when the origin and insertion of the external abdominal oblique muscle has been described.

The *musculus abdominis obliquus externus descendens* is situated throughout its extent immediately behind the fascia superficialis, and forms the first muscular layer of the anterior and lateral boundaries of the abdomen: it is fleshy superiorly, posteriorly and laterally: and tendinous at its lower and anterior surface. This muscle *arises* from the eight inferior ribs, close to their cartilages; on the fifth and sixth ribs it is, by tendon and muscular fibre, connected with the pectoralis major; on the sixth, seventh, eighth, ninth, and tenth, it digitates with the serratus magnus muscle; and on the eleventh and twelfth ribs it connects itself

with the latissimus dorsi, which partly covers it. From these origins. the fibres pass downwards and inwards to be *inserted* into the two anterior thirds of the outer edge of the crista ilii, forming a free posterior fleshy edge, which passes vertically from the last rib to the ilium; the fibres of the muscle are then continued obliquely downwards and forwards to the linea semilunaris, and are there intimately blended with the tendons of the internal oblique and transversalis muscles; from this line its tendinous fibres are continued in the same direction with its fleshy fibres to the middle of the abdomen, where, by interlacing with the tendon of its fellow of the opposite side, they together form the linea alba, into which it is said they are *inserted;* but besides this insertion, the iliac portion of the muscle also sends forth a tendon from the anterior and superior spinous process of the ilium, which forms a thick free edge, passes over the flexor muscles, vessels and nerves of the thigh, to the upper part of the pubes, to which it is fixed; being however above continuous with the rest of the tendon of the external oblique muscle. This free edge is termed Poupart's ligament, and forms the crural arch; its connection with the os pubis is threefold, as about an inch and a half from the bone it splits into two pillars, and thus produces an opening which is termed the external abdominal ring; the superior and internal pillar is broad and flattened, and is attached to the symphisis pubis, its fibres decussating those of the opposite side; the external and inferior pillar is round and strong, and passes to be inserted into the spinous process of the pubes; and from the posterior edge of this pillar a thin process of tendon runs backwards and outwards to be attached to about half an inch of the linea ilio pectinea, which is termed Gimbernat's ligament: it produces a concave edge looking upwards and outwards, and forms a boundary to the inner side of the femoral sheath. Where Poupart's ligament divides into the two pillars to be attached to the pubes, as has already been mentioned, a space is left, which is termed the external abdominal ring;

having its upper and outer angle strengthened by cross tendinous fibres. This opening is of a triangular form, directed obliquely downwards and inwards, and is broader above than below; it is for the purpose of giving passage to the spermatic cord and cremaster muscle in the male, and to the round ligament of the uterus in the female. This space, however, is not to be considered as being left open as a communication between the outer aud inner parts, being closed within by the tendons of the obliquus internus and transversalis muscles, and externally by the fascia of the cord and the fascia superficialis; it is, however, through this space that the bowels protrude in inguinal hernia.

Several openings are to be observed in the aponeurotic portion of the obliquus externus, besides those already mentioned, which are for the passage of the ramifications of blood-vessels and nerves, and which sometimes permit the protrusion of the abdominal viscera, producing what is termed ventral hernia.

The fleshy fibres of this muscle vary, both in their length and direction, in different parts of its extent; its upper fibres are short, and nearly vertical; the middle are the longest, and descend from without to within; while the posterior fibres are thick, short, and pass nearly vertically from the last ribs to the ilium: so that the result of the action of this muscle depends upon a direction given to the moveable parts in a line intermediate to the combined forces of its collective fibres.

Use.—The obliquus abdominis externus descendens contracts the capacity of the abdomen, consequently compresses the viscera of that cavity, and assists therefore in the passage of their contents; it also acts violently in vomiting, and assists in the expulsion of the fœtus. It depresses the ribs, diminishes therefore the capacity of the chest, and acts in expiration, in coughing, sneezing, laughing, &c.; and by pressing the viscera against the diaphragm, is indirectly producing hiccough. When acting singly, they incline the thorax obliquely downwards to the opposite side of that muscle which is in action; and when they both act, the thorax is drawn directly forwards and downwards towards the pelvis. In the recumbent posture, and in climbing, these muscles raise

the pelvis and lower extremities towards the thorax; they also render the fascia lata of the thigh tense; and lastly, act as opponents to the sterno cleido mastoidei by depressing the sternum.

To expose the second layer of the abdominal muscles, the m: obliquus externus must be separated from its costal and iliac attachments, and its tendon divided a little above Poupart's ligament, from the anterior and superior spinous process of the ilium to within an inch of the external abdominal ring; the whole muscle is then to be reflected towards the linea semilunaris.

The *obliquus abdominis internus ascendens* is thus exposed: in form it resembles the last described muscle, but its fibres pass in a contrary direction: it is more fleshy below than above; it is covered in front by the obliquus externus, posteriorly by the latissimus dorsi, and lies upon the musculus transversus abdominis. The internal oblique muscle *arises* posteriorly from a very strong fascia, common to this and other muscles, which is termed the fascia lumborum, and which is formed of three aponeurotic membranes; the posterior layer proceeding from the spinous processes of the lumbar vertebræ and sacrum; the middle one, from the apices of the transverse processes; and the anterior and thinnest layer, continuous with the fascia iliaca, passes over the quadratus lumborum, and thus forms sheaths for the lumbar muscles. From the strong posterior layer of this fascia, from the whole length of the middle labium of the ilium, and from the outer half of Poupart's ligament, the internal oblique muscle *arises*; from its fascial and posterior iliac origins the fibres are directed obliquely forward and upwards to the thorax; from the anterior part of the ilium they take a transverse course to the median line, and from Poupart's ligament they incline obliquely downwards and inwards towards the pubes, presenting below a free and slightly concave edge. The obliquus abdominis internus is *inserted* tendinous into the cartilago ensiformis; tendinous and fleshy into the edges of the cartilages of the six inferior ribs. At the linea semilunaris this muscle becomes wholly

tendinous, and is connected with the external oblique muscle; but here the tendon of the internal oblique splits into two layers, the anterior of which, with the tendon of the external oblique, passes in front of the rectus muscle to be inserted into the whole length of the *linea alba;* while the posterior layer, accompanied by the tendon of the transversalis muscle, passes behind the rectus to the same insertion, excepting at its lower fourth, where it is said to pass in front, but should rather be described as becoming here so attenuated as to be lost in cellular membrane. Those fibres of the muscle arising from the outer part of Poupart's ligament form a tendon which pass in front of the spermatic cord, behind the external ring, and is inserted into the symphisis pubes, being connected intimately with a similar tendon of the transversalis muscle.

Use.—The use of this muscle is to assist the external oblique muscle of the abdomen in all its actions; but it is to be remembered, that the internal oblique of the one side, cooperates with the external oblique of the other, in producing the rotatory motions of the trunk.

To expose the third layer of the abdominal muscle, the internal oblique muscle should be raised from the cartilages of the ribs, from the fascia lumborum and from the crista of the ilium as far forwards as the anterior and superior spinous process; immediately below which point it is so strongly adherent to the transversalis muscle, that care must be taken that its fibres are not raised with it; this may be avoided by observing branches of the circumflexa ilii artery, which are between them: the muscle is then to be reflected as far as the linea semilunaris, the portion arising from Poupart's ligament being left in its natural situation.

The *musculus abdominis transversus* is thus exposed: it is broader before than behind, fleshy at its superior lateral and inferior aspects, but tendinous at its anterior and posterior surfaces: its exterior is covered by the two last described muscles, while its interior face is in contact with the fascia transversalis, which separates it from the peritoneum: this

fascia will be described when speaking of the parts connected with hernia. The musculus transversalis abdominis *arises* tendinous from that layer of the fascia lumborum which is connected with the transverse processes of the last dorsal, and four superior lumbar vertebræ; also tendinous from the posterior part of the ilium, fleshy from the remaining part of the middle labium ilii, and from the posterior surface of the outer third of Poupart's ligament, in connexion with the obliquus internus: above it *arises* from the seven inferior ribs, tendinous from the two last, and fleshy from the five superior, where it is in contact with the origins of the diaphgram, but does not distinctly, as is usually described, indigitate with them. From these points of attachment the fibres pass transversely to the linea semilunaris, there become tendinous, and accompany the posterior layer of the tendon of the internal oblique muscle behind the rectus in the upper three-fourths of its extent to be attached to the linea alba, while the lower fourth passes with the anterior layer of the tendon of the obliquus internus and externus muscles to be *inserted* into the same line; that portion arising from Poupart's ligament in common with the musculus obliquus internus is attached tendinous to the pubes, forming with it an inseparable insertion.

Use.—The transversalis muscle, by its contraction, diminishes the capacity of the abdomen, and necessarily compresses the viscera of that cavity in a similar manner to the oblique muscles, forcing up the diaphragm into the chest; but it further lessens the capacity of the thorax, by drawing the ribs on one side towards those on the opposite; it also assists in the contortions of the trunk.

The *musculus cremaster* is a small muscle which, in the male, passes out through the external abdominal ring, completely surrounding the spermatic cord; it is composed of fibres which are given off from the internal oblique and transversalis muscles, although it is sometimes described as having a distinct origin from Poupart's ligament and the os ilium; it then passes down with the cord, and spreads itself to be attached to the tunica vaginalis reflexa, into which it

is inserted. During the fœtal period, this muscle seems to take its course upwards along with the gubernaculum, through the internal ring, and may therefore be considered as aiding, if not producing the descent of the testicle; this idea, perhaps, may be further strengthened by the fact, that there are no corresponding muscular fibres in the female. The cremaster muscle forms one of the coverings in inguinal hernia in the male, and its fibres are in these cases sometimes found very much thickened; it compresses and draws the testicles upwards towards the external ring.

The reflected muscles should now be placed in their relative situations, and the remaining muscles of the abdomen may be dissected by making an incision from the junction of the cartilage of the eighth with the seventh rib downwards to the spinous process of the pubes; by this incision you divide the anterior layer of the sheath of the rectus midway between the linea alba and semilunaris, and expose the

Musculus rectus abdominis, which is a long flat muscle passing vertically in the anterior and middle part of the abdomen; *arising* by tendon from the fore part of the pubes, it ascends, becoming broader and thinner, to be inserted into the ensiform cartilage, and into the cartilages of the three inferior true ribs. In this extent, the rectus muscle is not composed of one uninterrupted course of muscular fibre, but is divided by the three tendinous intersections of the lineæ transversæ; which have been before described as passing from the lineæ semilunares to the linea alba. The rectus muscle on either side is enclosed within an aponeurotic sheath, which has been explained by the account given of the insertion of the oblique and transverse muscles of the abdomen; namely, that the whole of the tendon of the external oblique and half of the tendon of the internal pass in front of the rectus muscle to be inserted into the linea alba; while the posterior half of the internal oblique, and all of the tendon of the transversalis abdominis passes behind it, excepting in the space below the point, midway between the umbilicus and os pubis, where all the tendons

pass in front of the rectus muscle ; or, more properly, it may be said, at this point they are lost in cellular membrane: so that the recti muscles at this lower part of the abdomen have nothing intervening themselves and the viscera but the thin fascia transversalis and peritoneum, enabling them more effectually to compress the viscera of the pelvis,—which is one of the principal uses of these muscles,—as well as to bend the trunk forwards, and to raise the pelvis towards the thorax.

In the lower part of the sheath of the rectus, on each side of the linea alba, there is frequently found, although not so often in the male as in the female, a muscle, which is named from its form the

Musculus pyramidalis; it *arises,* broad and fleshy, from the superior part of the pubes anterior to the origin of the rectus, from which it is separated by the aponeurosis of the transversalis muscle; while anteriorly it is bounded by the united tendons of the internal oblique and transversalis muscles, and superior pillar of the external ring: from its origin it passes upwards and inwards to be inserted into the linea alba midway between the pubes and umbilicus.

Use.—The use of the pyramidalis is to assist the rectus in compressing the viscera of the pelvis (hence more frequently found in the female than the male), and to render the linea alba tense. Its directions of action are downwards and outwards; it is occasionally found on one side only.

These five pairs of abdominal muscles being dissected, the student should consider their collective uses; and he will see how the use of each is common to them all. They all form the parietes of the abdomen: and the direction in which these fibres cross each other, adapt them in the best possible manner, not only to sustain the viscera contained within the abdomen ; but also at the same time to prevent their protrusion. They are also by their contractions destined to assist in the function of these viscera. We therefore find an arrangement, that their force may be equally applied through every part of the abdomen ; and to effect this, it

will be found, that the tendinous part of the one muscle corresponds to the fleshy part of another, so as to preserve an equal thickness and power throughout. They all tend, also, to draw down the ribs, and to diminish therefore the capacity of the chest in a direction which may be readily comprehended by attention to the origin and insertion of each muscle.

Until of late years, such an account as I have already given finished the description of the abdominal parietes. It was left to Sir Astley Cooper to discover a structure, which, in a pathological point of view, is of the greatest possible importance; as hernia, before this discovery, could but have been imperfectly understood. In the year 1801, on the failure of an operation for hernia performed by one of the ablest surgeons of the metropolis,—who considered that he had returned the protruded intestine into the abdomen, but notwithstanding which the patient died under a continuation of the symptoms of hernia,—it was found, upon a *post mortem* examination, that, although the intestine had been pushed behind the transversalis muscle, it still remained external to the abdominal cavity. It was this circumstance which led to the discovery of a structure which had not hitherto been understood by anatomists. Sir Astley Cooper, whilst making a careful examination of the abdominal parietes, upon raising the transversalis muscle from what he supposed to be the peritoneum, discovered that a fibrous tissue was interposed, lining the whole of the inner surface of this muscle. To this structure he gave the name of *fascia transversalis*. The importance of this fascia may be inferred, from its forming a passage to the spermatic cord, and thus becoming implicated in inguinal hernia; and from its passing down upon the thigh, thereby being equally involved in femoral hernia. But before entering into the minute account of this important fascia, so that all its various relations may be comprehended, it will be well to bring to the student's recollection the great and open space which is left between the cavity of the abdomen and the

thigh: a space bounded behind by the pubes and ilium, and in front by Poupart's ligament; in which latter situation it is so occupied by muscles, arteries, veins, nerves, absorbents, and fasciæ, passing from the abdomen to the thigh, as, under ordinary circumstances, to prevent the descent of the abdominal viscera. With these preliminary remarks, I may now proceed to the account given by Sir Astley Cooper of the fascia transversalis. It may be said to proceed above from the common origin of the diaphragm and transversalis muscle, in which situation, and as it proceeds laterally, it is so attenuated as to be scarcely distinguishable from the common cellular membrane; but as it descends between the transversalis muscle and peritoneum, towards Poupart's ligament, it assumes the distinct fibrous tissue; and in the iliac region, midway between the spinous process of the ilium and pubes, it divides itself into two portions—an outer or iliac, an inner or pubic portion; and these portions so separating as to produce a space termed the internal ring. The iliac portion, which is the stronger, is firmly attached to the inner labium of the crista ilii, and terminating by being inseparably connected with Poupart's ligament in such a manner as to present a concave edge facing towards the pubes, and forming the outer margin of the internal ring. *(Vide Plate* I. 1, 1.*)* The pubic or inner portion, which is thin, less distinct, and on a plane posterior to the other, passes downwards, leaving an edge concave outwards to form the inner margin of the ring *(Vide Plate* I. 2, 2, 2, 2.*)* and is continued downwards behind Poupart's ligament into the thigh, where it forms the anterior layer of the sheath of the femoral vessels, and may be traced as far as where the femoral artery penetrates the tendon of the adductor magnus. The pubic portion of the fascia transversalis, before it passes Poupart's ligament, is firmly connected with the united tendons of the internal oblique and transversalis muscles; and being situated immediately behind the external ring, assists in shutting out that opening from the abdominal cavity.

The Anatomy of Hernia.

In the dissection of the abdominal muscles and fasciæ, all the parts connected with inguinal herniæ are exposed, and should be most minutely examined in the following order.

The skin and superficial fascia being removed from the lower part of the abdomen, the aponeurotic expansion, or tendinous insertion of the external oblique muscle, is to be observed passing by a distinct free edge obliquely downwards and inwards from the ilium to the pubes; and within an inch of that bone it splits into two pillars, so as to form an opening called the external abdominal ring; which is described usually as being of a triangular form, the pubes constituting the base of the triangle, and the point of separation of the tendons the apex: but if the external angle of the ring be examined carefully, it will not be found pointed, in consequence of some transverse fibres which pass from one pillar to the other, thus rounding it off so as, in fact, to make this the large part of the opening, the size of which varies much in different individuals; sometimes forming such an aperture as just to allow of the passage of the cord, and in other instances producing a considerable separation. The external ring, however, is not to be considered as a distinct opening; for, from the edges of the pillars, a thin fascia proceeds along the cord, giving a covering to it so as to form a prolongation like the finger of a glove: and besides this, the fascia superficialis also tends to close it; and both these fasciæ must therefore be cut away before the pillars of the external ring can be brought into view. The dissection of the parts of hernia is further prosecuted by making an incision through the tendon of the external oblique, beginning an inch above the external ring, and carrying it outwards to the ilium; then separating the edges of the cut tendon, the parts underneath are exposed, and immediately the cord in the male subject, and the round ligament in the female, will present itself to view, taking a course

obliquely upwards and outwards to a point midway between the superior spinous process of the ilium and pubes, where it is lost by passing into the abdomen through the internal ring. The space between the two rings is termed the inguinal canal. In the female subject, this canal is better defined; first, because of its greater extent in consequence of the great breadth of the pelvis; and, secondly, because there is no cremaster muscle; but in both subjects it presents the following distinct boundaries.

Above, by the free edges of the internal oblique and transversalis muscles, as they are passing from the outer third of Poupart's ligament to be inserted tendinous into the pubes.

Below, by Poupart's ligament.

Anteriorly, by the tendon of the external oblique muscle; and,

Posteriorly, by the pubic portion of the fascia transversalis, which is passing down behind Poupart's ligament upon the thigh to form the anterior layer of the sheath of the vessels. As has been mentioned, this canal is occupied by the spermatic cord in the male, which should now, in this course of the dissection, be more minutely examined; and it will be found to be completely surrounded by muscular fibres; anteriorly by the cremaster, and posteriorly by fibres of the transversalis muscle; so that it is, in fact, running through a muscular canal. The space between the two rings measures from two to three inches, which is therefore the length of the inguinal canal. The internal ring should next be examined, which will be found just as the external,—not to be a hole through a membrane, but an aperture left by the division of the fascia transversalis into two portions; nor can this aperture be distinctly seen, until a small delicate fascia, which proceeds from the edges of the ring to the cord, be cut through; and then the cord itself may be seen passing into the abdomen through the internal ring, and getting between the fascia transversalis and peritoneum, is lost to

the view. There is yet connected with these parts a most important vessel to be observed, the epigastric artery, which is given off by the external iliac artery close to Poupart's ligament, passes upwards towards the umbilicus, behind the pubic portion of the fascia transversalis, and consequently behind the cord, and may be seen just on the inner side of the internal ring; the cord, at this point, being on its outer side. *(Vide Plate* I. 3.*)* It is the knowledge of the relative situation of this artery, which renders the division of the stricture in inguinal hernia safe; whereas, ignorance of it, may lead to fatal consequences.

The protrusion of any of the abdominal viscera through either or both of the rings, is termed an inguinal hernia; but these displacements do occur under such different circumstances, as to have led surgeons to divide inguinal hernia into different species, naming them variously; partly in consequence of their direction, partly from their situation, and partly in reference to their relative position with the epigastric artery. The most common kind is termed *oblique inguinal hernia;* or, by some anatomists, *external inguinal.* The first name describing its oblique course, and the second its being situated on the outer side of the epigastric artery.

This hernia passes through the internal ring, bringing with it a portion of peritoneum, which is called the hernial sac; it forms a small tumour in the inguinal canal, and has a tendency to protrude in the course of the cord, meeting in that direction with the least resistance, and progressively makes its way towards the external ring, having the cord placed behind it; while in this situation, between the two rings and within the inguinal canal, this swelling is termed *bubonocele.* If the swelling can be pushed back into the abdomen, the hernia is called a reducible one, if not, an irreducible one; and, lastly, if vomiting, and the usual symptoms laid down in books of surgery, point out that the intestinal canal in this part is rendered impervious by stricture, then it is called a strangulated bubonocele; and

requires, should the taxis and other recommended means fail, an operation; which is performed by laying bare, one by one, the coverings of the protruded intestine: first, the *skin,* in the whole length and course of the tumour; secondly, the *fascia superficialis,* and in this cut a branch of the external epigastric artery is divided, and does sometimes require a ligature; thirdly, the *tendon* of the *external oblique* is split up cautiously, in the same direction as the other incisions: and now the inguinal canal is exposed, and in it the hernial sac, bounded below by Poupart's ligament and cremaster muscle; above, by the free edges of the internal oblique and transversalis muscles, which are separated from the cremaster by the protruding tumour; and behind, by the cord. Before the hernial sac is opened, the surgeon should examine the precise situation of the cord, as it does sometimes happen to be split, so that the vessels may be in front of the tumour, and the vas deferens behind; having ascertained this fact, the *sac* is in the most cautious manner to be opened, and split up upon a director the whole length of the tumour; during which operation, more or less fluid generally escapes. The narrowest part of the tumour is now perfectly exposed, which is called the neck, and which is, in fact, the seat of the stricture, caused by the compression of the internal ring; and, as has been lately discovered by Sir Astley Cooper, is produced by fibres of the transversalis muscle, which passes first from the ilium in front of the cord, winds round it, gets thus behind it, and passes back again to the ilium; thus forming the ring into a complete sphincter muscle, and readily explains, both anatomically and pathologically, the seat and cause of stricture on the intestine, as well as the *rationale* of the effects of bleeding, tobacco, &c., in strangulated inguinal hernia. The stricture is now to be divided by passing a director between the bowel and the sac; or, should there be omentum as well as intestine, it should be placed between the director and bowel, as injury to that membrane is of much less importance than to the intestine; then passing a hernia-knife along the

director most cautiously, a slight incision is to be made through the fibres of the transversalis muscle and fascia, in a direction vertically upwards ; avoiding the epigastric artery, which is placed just to the inner side of the stricture. The contents of the sac should now be examined with a delicate manipulation, and be returned into the abdomen, or left in the sac, according to circumstances belonging more to the consideration of a surgical than an anatomical writer, and to whom, therefore, I must refer my readers.

The second kind of inguinal hernia is also termed oblique; but besides taking the same course in the direction of the cord, as the last described, passes through the external abdominal ring into the scrotum, and is termed *scrotal* hernia, or *oscheocele.* In the first part of its course, that is to say, while within the inguinal canal, it is precisely in every anatomical consideration the same as the bubonocele ; but immediately that it passes through the external abdominal ring, it becomes altered in form as well as acquiring another texture for a covering ; but this is not an additional covering, for it loses the tendon of the external oblique muscle, and gains as a substitute the cremaster muscle. This hernia, as it descends into the scrotum, continues in front of the spermatic cord, and descends in old herniæ as low as to the point where the tunica vaginalis testis is reflected from the gland. The tumour is of a pyramidal figure, having the apex situated at the ring ; but this apex does not, as it appears, terminate at the external ring, but, as a narrow neck, proceeds upwards and outwards along the inguinal canal to the internal ring ; at which point, when this hernia becomes strangulated, the stricture is situated. The steps in the operation to relieve this species of hernia, are the same as those in the preceding kind, excepting that the tendon of the external oblique muscle has not to be divided, in consequence of the tumour having passed through the external abdominal ring ; but still it is to be recollected, that there are the same number of coverings to separate, or, I might almost with propriety use the phrase, to peel off

the protruded intestine; as it has, in escaping from the inguinal canal, become covered by the cremaster muscle. The intestine being exposed, the stricture,—which is situated as in the other species of hernia at the internal ring,—is to be divided. Why, therefore, is now the question, should not the tendon of the external oblique muscle be split up, and the inguinal canal exposed? The answer is, that, as the hernia protrudes and falls into the scrotum, the weight of intestine, and probably also the action of the transversalis and cremaster muscles, draw the internal ring downwards and inwards so near to the external as to render it unnecessary to open the inguinal canal; indeed, this canal is obliterated by the proximity of the two rings. The situation of the epigastric artery, in relation to the stricture, is the same in both herniæ; and, consequently, the direction of the incision to divide the stricture is similar in each. Such are the circumstances usually concomitant with inguinal herniæ; but the protrusion of part of the intestinal canal through the abdominal rings, are sometimes occurring under varieties which complicate the disease, both in relation to diagnosis and operation. For instance, it does sometimes occur, that the tunica vaginalis is not closed at the internal ring, but that the cavity between the tunica vaginalis testis and reflexa remains open to the cavity of the peritoneum; in which case, a portion of intestine may slip down into the scrotum, within the vaginal cavity, and without bringing with it any other hernial sac. This species of hernia is termed *congenital;* but perhaps, improperly, as it is the tendency to, rather than the disease itself, which is to be considered congenital. There are also encysted herniæ; varieties of situation with respect to the spermatic cord; herniæ which are complicated with hydrocele; diseased testicle; varicocele; and other diseases, which may render the diagnosis difficult. Hernia, therefore, is a subject which requires the greatest attention of the student; and the mind of the surgeon should be particularly directed to the earliest symptoms which pointed out a deviation from health,

as well as to the local appearances, to which, however, careful investigation will generally facilitate the means of forming a just diagnosis; and, more especially, as to the precise point where the swelling commenced, which, in oblique inguinal hernia, is invariably at the internal ring, so that the tumour is felt midway between the spinous process of the ilium and pubes, immediately it protrudes; while, on the contrary, hydrocele, diseases of the testicle, &c., commence from the lower part of the scrotum.

There is yet another species of inguinal hernia, and which differs essentially from the oblique, from not passing through the internal ring, and from being placed on the inner side of the epigastric artery; on which account, it is sometimes called *internal* inguinal hernia; or *ventro* inguinal, from passing directly from the cavity of the abdomen through the external ring; but, more frequently, *direct* inguinal hernia, in contradistinction to the oblique, from passing perfectly straight from the abdomen, and not taking the course of the cord. If the tumour in this hernia be large, it is difficult to tell it from an oblique hernia; for the intestine meeting with least resistance outwards, the tumour appears to take an oblique direction: but should the intestine become strangulated, so as to render an operation necessary, one of the coverings peculiar to this rupture at once points out the nature of the disease. This covering is the tendon formed by the internal oblique and transversalis muscles, which passes behind the external ring to be inserted into the pubes, and is necessarily protruded with the intestine, as well as the portion of the fascia transversalis, which is connected with it. This is the only hernia which protrudes with a tendinous covering through the external ring; and therefore, when this structure is found, the nature of the disease is at once known; and the division of the stricture, as in the preceding species of hernia, may be made directly upwards: thus avoiding the epigastric artery, which is on the outer side of the neck of the sac.

Femoral, or *crural hernia*, is distinctly different from

those already described, in not passing through either of the rings, but protruding from underneath Poupart's ligament, and forming a tumour upon the upper part of the thigh; therefore it becomes necessary to describe the parts upon the upper region of the thigh, which are connected with this hernia, before it can be comprehended. On removing the skin from the anterior part of the upper third of the thigh, we bring into view the superficial fascia, which has been already alluded to as a continuation of the aponeurosis of the external oblique; and immediately below Poupart's ligament it divides itself into layers enveloping the superficial inguinal glands, and binds them firmly down to the subjacent structure. On removing this fascia and the glands, we expose the fascia lata, a strong aponeurosis giving more intimate covering to the muscles of the thigh. It takes its origin by two distinct portions, which very much resembles the mode by which the transversalis fascia terminates, each leaving an open space between the two portions. The outer, or iliac portion of the fascia lata, arises from the whole extent of Poupart's ligament, passes downwards upon the thigh, presenting a concave or cresentic edge facing inwards, which, on the outer side, slightly overlaps the sheath of the femoral vessels, and terminates from an inch to an inch and a half below Poupart's ligament by joining the pubic portion. (*Vide Plate* I. 4, 4, 4.) The pubic portion proceeds from the spinous process of the pubes from Gimbernat's ligament and linea ilio pectinea, and from Poupart's ligament; situated on a plane posterior to the other, it passes down upon the inner side of the thigh, covering the pectineus muscle, proceeds outwards as far as the femoral sheath (*Vide Plate* I. 5, 5, 5.); there splits into two layers, one of which passes posterior to the sheath, becomes connected with the fascia iliaca and capsular ligament of the hip-joint; the other, passing anterior to the vessels, joins the outer or iliac portion of the fascia lata, as mentioned above: thus a foramen is completed, which admits the termination of the saphena major vein into the femoral vein. Through the whole

course of the inner side of the thigh this vein is found external to the fascia lata, between it and the superficial aponeurosis, until it becomes lost at this point; below which the two portions of the fascia form one uninterrupted aponeurotic expansion. The edges of the cresentic opening are rendered indistinct by a process of fascia which connects them with Poupart's ligament; this portion allows the passage of absorbent vessels from the superficial to the deep inguinal glands, and is by some anatomists termed the middle portion of fascia lata; until this is removed, neither the crescentic opening or the sheath of the femoral vessels are brought fairly into view.

It is now only necessary to describe the parts connecting the abdominal cavity with the thigh.

We have already adverted to the mode in which the thigh is connected to the abdomen by means of the different structures which pass under Poupart's ligament; namely, the psoas iliacus and pectineus muscles, the crural nerves, femoral artery, vein and absorbents. Gimbernat's ligament also assists in diminishing the size of the arch, and may be said to form its inner boundary. As regards the relative situation of these structures, the muscles will be found immediately applied to the bony margin of the pelvis; and lying on them we shall see the femoral artery in the centre, having to its outer side the nerve, to its inner the vein. To the inner side of the vein, between it and Gimbernat's ligament, is a small space apparently filled up by cellular membrane and soft adipose structure, but which transmits the absorbents from the thigh into the abdominal cavity. It now remains to be shewn, how the passage of the artery, vein and absorbents are secured by the adaptation of two fasciæ; the one derived from the anterior, the other from the posterior abdominal parietes: both of which descend with the vessels under Poupart's ligament; and, contracting around them, prevent, under ordinary circumstances, the protrusion of the abdomial viscera through the same opening. One of these membranes, the fascia transversalis,

has already been described as forming the immediate anterior abdominal parietes, and dividing into two portions—the external attached to Poupart's ligament, the internal passing into the thigh, and covering the crural vessels. This last portion, in its descent, is extended inwards beyond the femoral vein as far as Gimbernat's ligament, to which it is attached. The second membrane is called the fascia iliaca, and is situated in the iliac fossa ; commencing at the inner labium of the crista of the ilium, and extending downwards towards the crural arch, covering the iliacus and psoas muscles. It thus lies immediately behind the peritoneum, and consequently forms the posterior abdominal parietes. Having reached the line between the spinous processes of the ilium and pubis, the fascia iliaca terminates on the outer side by being inserted into the external half of Poupart's ligament, in common with the corresponding portion of fascia transversalis; while on the inner, it descends into the thigh behind the femoral vessels, and thus constitutes the posterior layer of their sheath. It is also attached, in common with the fascia transversalis, to Gimbernat's ligament; and the sheath is completed by the junction of the two membranes on either side of the vessels. By this arrangement it will be understood, that the outer half of the crural arch is perfectly secured by the junction, or common attachment to Poupart's ligament, of the two membranes derived from the anterior and posterior surfaces of the abdomen; while on the inner half, an elliptical opening is left communicating with the thigh, and occupied by the vessels together with the same membranes, descending before and behind them, forming their sheath. It is this sheath, which is seen through the cresentic opening of the fascia lata, partly overlapped by its external edge and lost to view below, where the two portions of the aponeurosis join. In shape it resembles a funnel, being wide above where it emerges from under Poupart's ligament, and becoming suddenly contracted around its contents as they descend into the thigh. This contraction is particularly

abrupt on the inner side, so that the fascia transversalis appears to extend almost transversely from Gimbernat's ligament to the outer side of the femoral vessels. On opening the sheath the artery will be found separated from the vein by a slight process sent down between them. On the inner side of the vein are situated the deep-seated absorbents of the lower extremity: some of which are continued upwards into the abdomen, while others pierce the sheath to reach the inguinal glands. From this latter circumstance the name of fascia cribriformis has been given to that portion of the fascia transversalis which covers the inner side of the vein, and extends from it to Gimbernat's ligament. It is altogether of a looser and more yielding texture, rendering it occasionally insufficient to prevent the descent of a femoral hernia; for, from the foregoing description, it will be manifest, that any portion of the abdominal viscera, making its escape by the side of the vessels, must be opposed in its progress by their sheath. The opening which allows the passage of a crural hernia under Poupart's ligament, is that occupied by the absorbents on the inner side of the vein: it is called the femoral or crural ring; and is bounded on the outer side by the vein, on the inner by Gimbernat's ligament, before by Poupart's ligament lined by fascia transversalis, behind by the pubes covered by fascia iliaca. Into this opening the finger may readily be insinuated from the abdominal cavity, especially when the peritoneum is removed; but its progress downwards towards the thigh is checked by coming in contact with the fascia cribriformis extending, as it were, across the opening from the femoral vein to Gimbernat's ligament. This resisting structure, however, gradually yields before the pressure of a hernia, until at length the fascia cribriformis, together with a quantity of loose cellular tissue which assists in filling up the ring, becomes dilated into a pouch, which contains the peritoneal sac; and, projecting through the crescentic opening of the fascia, is immediately subjacent to the superficial aponeurosis. Thus although the hernia, while passing

under Poupart's ligament, is contiguous with the femoral vein, it becomes immediately received into, or, more properly, forms for itself a distinct cavity, derived from the sheath which it dilates before it. The covering which a hernia thus acquires, is frequently denominated the fascia propria.

The first external appearance indicating the presence of an incipient femoral hernia, is that of a tumour situated immediately below and rather to the outer side of the spinous process of the pubis, becoming, in its progress, larger and more superficial as it rises through the opening of the fascia lata. Its coverings will be found to be three in number, exclusive of the peritoneal sac: these are, first, the common integuments; and under it the superficial aponeurosis, probably involving one or more of the inguinal glands; on removing this we discover the third tunic, or fascia propria, which is always loaded, and consequently obscured, by more or less adipose structure. On dividing this last covering, the peritoneal sac will be brought into view. A crural hernia, however, does not always occupy the situation which has been described; for, as it increases in size by the successive escape of fresh portions of viscera, it will be found to take a direction upwards, turning over Poupart's ligament, and resting on the tendon of the external oblique muscle of the abdomen. The explanation of this apparently unnatural course, appears to consist in the firmness with which the superficial aponeurosis adheres to the crescentic edge of the fascia lata, together with the presence of the absorbent glands, whereby the hernia is prevented from descending into the thigh: while, at the same time, the looseness of the cellular tissue covering Poupart's ligament offers little mechanical resistance to its passage in that direction.

The situation assumed by a hernia is of the utmost importance: since the principles by which we attempt its reduction are founded upon a knowledge of the course which it pursues.

When the intestine is strangulated in femoral hernia, an operation must be performed to relieve it. The first incision through the integuments is made in the form of a reversed ⊥; the angles of the integument being then dissected upwards, the fascia superficialis is exposed; this fascia being reflected in the same manner, the fascia propria or fascia transversalis or the anterior layer of the sheath of the vessels comes into view—these three names all meaning the same covering to the hernia, and derive their different appellations from various authors; but it is to be remembered that it is, under each or all these names, the pubic portion of the fascia transversalis passing down from the abdomen on to the thigh. This being removed, the hernial sac presents itself; or, very frequently, a considerable quantity of fat covers it, and which may lead to some difficulty unless the surgeon is aware of the frequency of the existence of fat in that situation. The sac should now be most carefully opened, and more than usual precaution is required; first, because in a femoral hernia but a very small quantity if any fluid is found in the sac; and, secondly, because the protruded part is frequently a portion of intestine only, without omentum. The seat of stricture is now the object of the surgeon's attention; and, indeed, much variety of opinion exists as to this important subject:—some surgeons being of the opinion, that Gimbernat's ligament is the cause of strangulation; others, that it is Poupart's ligament; while Sir Astley Cooper contends it is at the neck of the sac, at the crural ring, where the constriction exists; and that the division of the fascia propria in a direction upwards and slightly inwards, will immediately liberate the intestine and divide the stricture. My experience would certainly lead me to the conlusion, that the division of Gimbernat's and Poupart's ligaments would never liberate a femoral hernia, unless the fascia propria was divided at the crural ring in the manner as recommended by Sir Astley Cooper.

There are varieties with respect to the origin of the obturator artery which complicate the division of the stricture

in this hernia; and I therefore recommend the student to consult treatises on this subject, with peculiar caution; and can recommend Sir Astley Cooper's and Mr. Lawrence's works, as entering deeply into this subject, and describing in detail all such surgical points as render the operation comparatively easy to an anatomist.

Wounds and Injuries of the Abdomen,

Are also subjects which should be particularly attended to; as the effects of them are frequently fatal, although there may appear to be but little external signs of violence.

They may be divided into the following classes:—

First.—Where the parietes only are injured, without the peritoneum being affected,

Secondly.—Where the peritoneal cavity is laid open, but without injury to the abdominal viscera.

Thirdly.—Where the abdominal viscera themselves are also injured, either by the instrument inflicting the wound, or from their protrusion through it.

Fourthly.—Where the viscera themselves are lacerated, producing extravasation of their contents into the cavity of the abdomen without external injury.

Each of these divisions are marked by symptoms peculiar to themselves, and require distinct treatment; subjects which are too lengthened, however, to permit an anatomical writer to treat of.

LECTURE XIV.

DESCRIPTIVE ANATOMY OF MUSCLES.

The Muscles of the Exterior of the Cranium and the Face.

Before I enter upon a minute description of these muscles, it is requisite to point out those circumstances in which, with respect to their functions, they differ from all the other muscles of the human body: namely, that during their contraction, they draw the integuments by which they are covered in various directions, without producing any change of position in the osseous parts to which they are attached.

There are thirteen pairs and a single muscle included in this classification; of which the three sphincter muscles, denominated *orbiculares,* are the principal, being for the purpose of opening and closing the eyes and mouth; the rest being employed to moderate and assist them in their action.

When the three orbicular muscles act, their edges are brought in contact; while, laterally, they are held from the centre by their attachments, and the moderating muscles, with their cutaneous coverings, are drawn towards the centre: when the orbicular muscles are opened by the contraction of their moderators, the skin covering them is made to radiate, as from a centre towards the circumference of a circle. In the special description it appears consistent to commence with the principal muscles, the orbiculares, and then to proceed with the description of their respective moderators, or the muscles which are subservient to their actions.

The *m. orbiculares palpebrarum.*—A circular incision around the bony edges of the orbits will expose these muscles; the fibres of which are thin and pale, and are found completely surrounding the orbits, and extending into the fibro-cartilages of the eyelids. They *arise* from the internal angular process of the os frontis, and from the groove which lodges the lacrymal sac in the superior maxillary bone; and also by a small tendon which attaches the tarsi of the eyelids to the nasal process of the same bone; from these origins the fibres spread outwards along the upper and lower margins of the orbit, and unite at the outer canthus, being there very loosely connected to the bones by cellular membrane. They are united above, to the m. occipito frontales and corrugatores superciliorum; below, a few fibres are connected with the skin of the cheek. The pale straight fibres of these muscles, which are forming a part of the eyelids, are sometimes described as separate muscles, under the name of musculi ciliares.

Use.—To close the eyelids and to compress the globe of the eye, and direct the tears from the outer towards the inner canthus. They draw the integuments downwards from the cranium, upwards from the lips, and inwards from the temples. Their most fixed point is at the internal angular process of the frontal bone; towards which their superior fibres are drawn in frowning, by the action of the musculi corrugatores superciliorum.

The muscles which moderate and assist in the action of the musculi orbiculares palpebrarum are the m. occipito frontales, the levatores palpebrarum superiorum, the corrugatores superciliorum, and the depressores labii superioris alarumque nasi.

If the fibres which form the connection between the m. orbiculares palpebrarum and the occipito frontales be raised from the inner canthi, the *musculi corrugatores superciliorum* will be exposed; which are small muscles *arising* from the internal angular process of the frontal bone; from which origin they pass upwards and outwards, as far as the centre of the superciliary ridge, to be *inserted*, by forming

an interlacement with the musculi orbiculares palpebrarum and the occipito frontales.

Use.—To draw inwards the skin and to elevate the hair of the eyebrows, expressing the passions of malevolence and anger.

The *m. occipito frontales.*—To expose these muscles an incision should be made on either side, transversely from the mezian line to the external angular process of the frontal bone; and a second incision commencing at the tuberosity of the occiput, and terminating at the nasal process of the os frontis. The integuments of the cranium should now be very cautiously reflected, for they will be found very dense and adhering firmly to the muscle and tendon beneath. The m. occipito frontales are fleshy anteriorly and posteriorly, and tendinous on their superior and lateral surfaces, covered throughout by a thick rough subcutaneous cellular tissue, by which they are firmly connected with the skin, and lying upon the pericranium. They *arise* posteriorly from the superior transverse ridge of the occiput, reaching outwards as far as the mastoid processes of the temporal bones; their fleshy fibres proceed upwards and forwards to the lambdoidal suture; then becoming tendinous, expand over the vertex of the cranium as far as the coronal suture; there again becoming fleshy, pass downwards to be *inserted* into the skin of the eyebrows, and to be connected with the m. orbiculares palpebrarum and corrugatores superciliorum, sending a fleshy slip downwards on the dorsum of the nose to join with the m. compressores narium.

Use.—To explain this it is necessary to divide these digastric muscles into their occipital and frontal portions. The frontal portions bring forward the skin of the forehead, at the same time wrinkling it transversely; and also assist in raising the upper eyelids, while the occipital portions draw backwards the skin of the head; and both put the central aponeurosis upon the stretch. These muscles may be considered as forming a distinct digastric muscle on each side of the head, as is proved by their single action during the winking of either eye.

The last muscles to be described as moderating the action of the orbiculares palpebrarum, are

The *m. levatores palpebrarum superiorum*, which, although not easily exposed at this stage of the dissection, cannot with propriety be omitted in this classification; although they must be again mentioned when describing the muscles situated within the bony orbits. These muscles *arise* from the superior edge of the foramen opticum of the sphenoid bone, proceed forwards upon the under surface of the orbitar process of the frontal bone, and becoming larger anteriorly are *inserted*, thin and tendinous, into the tarsus of the upper eyelid.

Use.—These muscles are passing from behind to before, describing a curve, the convexity of which is turned upwards, corresponding to the form of the ball of the eye, which form enables them to raise the eyelids; they also moderate the actions of the upper ciliary portions of the orbiculares palpebrarum, acting alternately with them, and preserving the moisture and transparency of the cornea, and protecting it from dust and strong reflections of light.

The third orbicular muscle surrounds the opening of the mouth, and is termed, therefore, the *orbicularis oris*. It is composed of two portions of circular fleshy fibres which pass around the lips, decussating each other on either side, and freely intermixing with the insertions of the muscles which moderate its actions, and which tend in a great measure to form it. This muscle is covered anteriorly by the integuments, and posteriorly is in contact with the lining mucous membrane of the mouth and lips; it is not attached to bone; immediately beneath the skin a considerable quantity of fat is mixed with its fibres, which are free from it posteriorly.

Use.—To close the mouth by bringing the lips in contact; by the action of the muscles intermixed with it, the mouth is opened; and by the alternate action of this sphincter and its moderators, the countenance is furnished with means of expressing all the varieties of emotion and passion.

The muscles which are employed in assisting and moderating the action of the orbicularis oris are ten pairs, and are situated around the opening of the mouth in the following order:—

Four pairs above the upper lip, three pairs by the side of

the mouth situated on the cheek, and three pairs below in connexion with the lower lip.

Those above are the m. compressores narium, levatores and depressores labii superioris alarumque nasi, and the levatoris anguli oris.

Those by the side, the m. buccinatores and zygomatici.

And, those below, the m. levatores and depressores labii inferioris, and the depressores anguli oris.

Before describing the origin and insertion of these muscles, it is right to point out the reciprocal action of the upper lip, and moveable parts of the nose, in the function of respiration; and we shall find, that three out of the four pairs of the muscles situated above the upper lip, produce a change of position in the cartilages of the nose and give motion to the lip simultaneously; and therefore may be considered as equally belonging to the nose and mouth.

The *musculi compressores narium*, although usually described as proper to the nose, are common to the nose and mouth; and hence must be classed as moderators to the orbicularis oris. They *arise* above from the dorsum of the nose, being there connected with some fibres of the occipito frontales; they then diverge, pass downwards and outwards on the sides of the nose, and are *inserted* by being connected with the fibres of the levatores and depressores labii, superioris alarumque nasi, and cartilages of the nose.

Use.—To moderate the actions of the occipito frontalis and orbicularis oris; they are made to dilate or compress the nares, according to the preponderating action of the levatores, or depressores labii, superioris alarumque nasi.

The *m. levatores labii superioris alarumque nasi, arise* by two portions from the superior maxillary bones; one from the nasal process, the other from the anterior part of the bone between the inferior ridge of the orbit and the infra orbitar foramen; extending as far outwards as the malar bone. From these points of origin the fibres pass downwards in two fasiculi, which converge: the inner fasciculus passes to be *inserted* into the ala nasi and upper lip; while the

outer one passes into the lip only, intermixed with the orbicularis and levatores anguli oris. The distinctness of the two fasiculi has led some anatomists to describe each as a separate muscle.

Use.—Their individual use is to raise the upper lip and alœ of the nose, producing the expression of contempt; but they are more frequently used as moderators to the orbicularis oris.

The *m. depressores labii superioris alarumque nasi,* are small muscles situated behind the lips, and are not exposed until the mucous membrane of the mouth is removed from the upper jaw: they *arise* from the superior maxillary bones from a small fossa just above the alveolar processes of the incisor teeth; they pass upward towards the posterior region of the wing of the nose, into which they are partly *inserted;* the rest of their fibres intermixing with the last described muscles and the orbicularis oris.

Use.—To depress the wing of the nose and upper lip, and assist in closing the nares.

The *m. levatores anguli oris,* arise from the depression below the infra orbitar foramen on the superior maxillary bone, being covered by the external or malar origins of the levatores labii superioris alarumque nasi; they pass downwards and outwards to be inserted by interlacing with the fibres of the orbicularis oris, and those muscles forming the angles of the mouth.

Use.—To raise the corners of the mouth upwards and inwards.

The *m. zygomatici,* are two small pairs of muscles embeded in a considerable quantity of fat, and extending across the cheek to the angles of the mouth.

The *m. zygomatici majores,* are situated externally and posteriorly to the zygomatici minores; they *arise* near the posterior angle of the malar bones, pass downwards and inwards crossing the buccinatores, from which however they are separated by a considerable quantity of fat, and are *inserted* into the corners of the mouth, uniting with the orbicularis oris, and its lateral moderators; each muscle

sometimes bifurcates so as to be connected with both lips at its insertion.

The *m. zygomatici minores*, are sometimes wanting; when present they *arise* on the inner side of the last described muscles from tbe malar bone; and passing down in the same direction, are *inserted* by joining with the fibres of the orbicularis oris and levatores labii superioris.

Use.—The zygomatici raise the corners of the mouth backwards and outwards, and thus produee the expression of joy and laughter.

Beneath the zygomatici, and covered by a considerable quantity of fat, are placed

The *m. buccinatores;* these muscles are thin and square, forming the muscular part of the cheek, and occupy the lateral space between the superior and inferior maxillary bones; they *arise* posteriorly from a ridge between the last molar tooth and the coronoid process of the lower jaw; also from the upper jaw between the last dens molaris and the pterygoid process of the sphenoid bone, from which they partly arise, as well as from the pterygoid process of the palate bone; in this situation being connected with the superior constrictor of the pharynx.

From these origins their fleshy fibres pass forwards to be *inserted* into the angle of the mouth; at the point of insertion decussating, so that the upper fibres pass to the lower lip, and the under ones to the upper, interlacing with the orbicularis oris. The cutaneous surface of these muscles is covered by the zygomatici muscles and fat, and traversed by the excretory duct of the parotid gland, which obliquely perforates it opposite to the third molar tooth. The internal surface of these muscles is lined by the mucous membrane of the mouth.

Use.—To draw the corners of the mouth baekwards, and to assist in the proeess of mastieation, by eompressing the cheeks and keeping the food between the teeth; and further, in blowing wind instruments, they eeonomise the air which is contained within the mouth.

The last set of muscles to be described as moderators to

the orbicularis oris, are the three pairs situated upon the chin below the opening of the mouth.

The *m. levatores labii inferioris,* are situated in a similar manner with respect to the lower lip that the depressores are with the upper, being placed between the mucous membrane of the mouth and the lower jaw. They *arise* just below the alveolar processes of the incisor teeth of the inferior maxillary bone; the fibres diverge as they pass downward to be *inserted* into the inner surface of the lower lip and the skin of the chin.

Use.—The use of these muscles is to raise the skin of the chin and lower lip in a direction inwards and backwards, so as to cover the teeth of the lower jaw.

The *m. depressores labii inferioris.*—To expose these muscles some of the attenuated fibres of the platysma moyides must be raised; they are flat and broad muscles, arising from the anterior and lateral parts of the inferior maxillary bone, extending as far outwards as the origin of the depressores anguli oris, and continue as far forwards as the middle line, where the muscle of each side approximates; from this attachment they pass upwards, their anterior fibres vertically, their posterior with obliquity inwards, to be *inserted* into the under lip, and to be connected with the orbicularis oris.

The depressores anguli oris partly cover the outer origin of these muscles.

Use.—To depress the lower lip.

The *m. depressores anguli oris,* are situated on the outer side of the last described muscles; their form is triangular, gradually diminishing in breadth from their origin to their insertion. They *arise* from the sides of the inferior maxillary bone, a little above its base, from a line extending from the root of the coronoid process to the anterior maxillary foramen, and pass upward to be *inserted* into the corner of the mouth, uniting with the zygomatici orbicularis oris and buccinatores. They are covered by the integu-

ments and platysma myoides, and partly cover the buccinatores and depressores labii inferioris.

Use.—To depress the angle of the mouth, and to assist the last described muscle in producing the expression of grief.

Having concluded the anatomical description of the muscles situated on the exterior of the cranium and face, I am desirous of detailing their physiological relations, in such a manner as to convey a conception of their multiplied and varied actions as connected with the function of respiration, and with the physiology and theory of expression. In the first place it will be remembered, that of the muscles of the face three are orbicular, surrounding the eyes and the mouth; and that the rest may be regarded as varying and modifying the direction of their action: and, secondly, that the muscles of the face are peculiar in moving the integuments; while the osseous parts beneath remain fixed. Bearing in mind these two facts, we shall find a ready explanation of all the modifications of their action and expression; whether induced by natural, excited, or impeded respiration, or by the feelings and passions of the mind. I would however observe, that notwithstanding all that has been said on the subject of physionomical expression; notwithstanding the many learned disquisitions that have been entered into, respecting the influence of feeling and passion upon the countenance; more mystery has, I think, been thrown over the subject, than it will, on a minute and careful examination, be found to deserve. We know that the expression of countenance in one whose respiration is greatly hurried or much impeded, is sufficiently explained by the consideration of the action of those muscles which are necessarily called into action by the increased necessity for their exertion. In this case, at least, the mere anatomical explanation is satisfactory, as to the expression; but in other instances, where certain passions or emotions are expressed, the connection between the passion or emotion, and the expression of countenance, is less obvious: and hence it is, that we are for the most part content with the fact, without

attempting to explain it. Upon the whole, however, I am disposed to conclude, that even in these cases, if not indeed in every case, a minute attention to the state of respiration will afford the true solution; or, in other words, that as in the expression of countenance indicative of, and produced by, an obviously hurried or impeded respiration; the modifications of the countenance, expressive of the various passions and emotions, may be traced to a certain state or condition of the muscles of expression called into existence by their subserviency to respiration,—that function being influenced by the particular emotion; the association being such as anatomy and physiology sufficiently explain.

Be this as it may we know, at least, that during any violently excited respiration, the chest becomes expanded, the shoulders raised, the mouth and nose opened, and the whole countenance thereby pourtraying a certain consequent expression; whilst any mental or morbid corporeal cause impeding respiration, has also its corresponding expression. Thus in grief, which may be fairly taken as an instance of impeded respiration, we find that the visage undergoes a change which marks the peculiar passion; and the expression of the face characterises the inward sensation, by its contracted state: the eyebrows approach each other, the mouth is drawn down, and the nose becomes pinched so as to diminish the size of the external openings; at the same time the chest is flattened, and its slowly alternating elevation and depression, with the occasional sigh or sob, sufficiently indicate an impeded respiration. While in the expression of joy, on the contrary, the whole countenance is lighted up, the eyebrows and eyelids are raised, the alœ of the nose and angles of the mouth are drawn upward; and the playful motions of the mouth denote the necessity of a corresponding change of form with the state of the lungs, which breathe with a freedom marked by the quickened elevation of the chest, and the occasional laugh, which is but a succession of frequent expirations. These passions in the best possible manner denote the reciprocal

action of the muscles of respiration and of the face; and as we advance further in the knowledge of anatomy, it will be found that the distribution of the nerves, as has been demonstrated by Mr. Charles Bell, corresponds with the phenomena related.

Practical Remarks.

It is obvious from the various functions to which the muscles of the exterior of the cranium and the face are subservient, and from the manner in which they are destined to move their cutaneous coverings, that in the treatment of all wounds to these parts, the surgeon should most studiously endeavour to diminish their motion, by keeping the edges of the wound in apposition with sutures, plaisters, and bandages; and, as has been stated, that respiration, modified by the passions, is the natural stimulus to these muscles,—physiology and pathology point out to us the propriety of warning our patients to avoid every mental excitement; for, in proportion as parts are subjected to motion, so is the adhesive inflammation disturbed, and a tendency to the suppurative promoted. Thus we find, that superficial wounds of the scalp become of serious importance in consequence of the frequent motion of the occipito frontales muscles; a danger which is much enhanced if the tendon of these muscles be wounded, not only from the motion, but also from the little power that structure possesses of reparation, suppuration and erysipelas frequently supervene: it is therefore essential in operations on the scalp, to avoid wounding this tendon.

Wounds about the orbits are subject to the same disturbance, from motion during their reparation, as the other parts of the head and face, and require, therefore, the same means to keep their edges in adaptation. Such injuries, however, are more serious, on account of the important function these parts have to perform; for should they interfere with the action of the orbiculares palpebrarum, the organ of sight itself may be affected by the diseases called ptosis, or lagopthalmos: in the former, the upper eyelid hangs down over the eye, caused by a disturbance to the adhesive inflammation, or paralysis to its nerve of motion; while, in the latter, the eyelid is drawn permanently upwards by a contraction of the cicatrix, so that the cornea is constantly exposed. It is said, that injury to the supra orbita nerve sometimes produces amaurosis; but there is reason to suspect the validity of this opinion, as the function of this nerve cannot, in any way, be traced as further necessary to vision than as destined to supply the tutamina oculi; and its division could therefore only indirectly and slowly affect sight. I am disposed to believe, that where amaurosis follows this accident, it is produced by the concussion of the optic nerve, and not in any way attributable to injury of the supra orbitar.

Wounds of the cheek are frequently productive of serious consequences, from injury to the parotid duct, attended with a constant flow of saliva, and producing a fistulous opening: but on this subject I shall treat more particulary when speaking of the salivary apparatus; only now recommending the early and perfect adaptation of the edges of the wound.

Muscles superficially situated on the anterior part of the Neck.

The neck is that part of the trunk situated between the thorax and cranium; it is divided into an anterior and posterior surface, each giving attachment to muscles: and those of the anterior region are now to be described. This region is bounded superiorly by thé inferior edge of the lower jaw, and mastoid processes of the temporal bones; inferiorly, by the sterno clavicular articulations, and the upper surfaces of the clavicles; and laterally by the anterior edges of the musculi trapezii, extending from the posterior part of the mastoid processes to the acromial extremities of the clavicles. In the median line of this region, the larynx is seen to project, and on either side of this projection the course of the sterno cleido maistoideus muscle is observed through the skin and platysma myoides, converging inferiorly and diverging in the upper and lateral regions; between the posterior edge of the sterno cleido mastoideus, and the anterior edge of the musculus trapezius, is a triangular depression, the base of which is formed by the clavicle. The muscles situated in the anterior part of the neck are numerous; but their dissection will be facilitated by taking them in the following order:—First, those which are superficially situated; secondly, those which fix the os hyoides; thirdly, those which depress the lower jaw; fourthly, the muscles running transversely from the temporal bone to the os hyoides; and, lastly, those which are deeply-seated on the vertebral column.

In commencing the dissection of the muscles superficially situated, an incision should be made through the skin only, from the symphisis of the lower jaw to the centre of the

clavicle; one portion of the skin is to be reflected forwards, and the other backwards; and thus a condensed fibro-cellular tissue, which has received the name of the *fascia superficialis*, is exposed. This fascia is continuous above with the fascia which covers the parotid gland; inferiorly it extends upon the thorax, there being continuous with the superficial fascia of the chest and abdomen; while on the neck it presents one continuous sub-cutaneous surface; but its muscular or deep surface sends off processes which pass down between the muscles to join the fascia cervicalis profunda, and give a complete covering to many of them. At the anterior edge of the trapezius muscle, it becomes attenuated and sends off a layer which passes beneath the platysma myoides so as to inclose it. The situations in which the superficial fascia is most firmly connected with the deep fascia, are above, between the angle of the jaw and styloid process of the temporal bone; and, below at the upper edge of the sternum, between the origins of the sterno cleido mastoidei. The fascia superficialis is now to be dissected from the neck, to expose

The *musculus platysma myoides*, which is a thin quadrilateral muscular expansion, situated on the anterior and lateral parts of the neck; it *arises* inferiorly from the cellular membrane covering the m. pectoralis major and deltoides; its fibres are at its origin separated from each other, but they gradually approximate as they ascend obliquely upwards and inwards to the basis of the inferior maxillary bone, to which they are attached; and then passing over the inferior part of the cheek *intermix* with the muscles of the face, and more especially with the depressores labii inferioris et anguli oris. It is inclosed within two layers of the superficial fascia, at the chin, being united with its fellow, but separated below, leaving a space where the fasciæ unite with each other, forming a dense resisting membrane. The external jugular vein takes its course beneath the platysma myoides, passing to the lower and clavicular origin of the sterno cleido mastoideus, to terminate in the sub-

clavian vein, being situated between the superficial and deep fasciæ of the neck.

Use.—This muscle assists in depressing the lower lip and corners of the mouth, wringles the skin of the neck transversely, assists in depressing the lower jaw, and may be said in some measure to assist also in the motions of the head.

On removing the platysma myoides muscle, the *fascia cervicalis profunda* should now be traced to its attachments. It forms a dense aponeurotic expansion, and proceeds as a continuation of the ligamentum nuchæ around the neck. Above it is attached to the lower jaw, being connected there with the pterygoideus internus muscle, and passing downwards and backwards to the styloid process of the temporal bone, forming the stylo maxillary ligament, which separates the submaxillary from the parotid gland. It proceeds from this point forwards to the anterior edges of the sterno cleido mastoideus, and there becomes connected with the superficial cervical fascia; it then continues forwards to the mesian line; in its course above, giving a covering to the submaxillary gland and muscles, between the os hyoides and lower jaw; below, to the larynx and trachæa; and sends off processes to the muscles in the neighbourhood of the larynx, which pass deeply between them, so as to form sheaths around them; it then descends connected laterally with the anterior edges of the sterno cleido mastoidei to the sternum, where it divides into two layers; the anterior, being subcutaneous, to be connected with the superficial fascia; while the deep one, which had invested the omo hyoideus muscle, passes to surround the m. subclavius, from the anterior edge of which it passes to the corocoid process of the scapula, and to the anterior surfaces of the two superior ribs; being in this situation so firm as to have received the name of costo coracoid ligament. This ligament is highly important from giving a covering to the subclavian artery and vein, in the space precisely corresponding to the division between the sternal and clavicular portions of the m. pectoralis major. From the posterior edges of the sterno

cleido mastoidei, this fascia proceeds downwards upon the chest, and becomes connected with the superficial cervical fascia.

The *m. sterno cleido mastoideus.*—This muscle is exposed by the removal of the deep cervical fascia. It is a thick fleshy muscle, about two inches in breadth, situated in the anterior and lateral parts of the neck, which it divides into an anterior and posterior region. This muscle *arises* by two distinct portions; the inner origin is thick and tendinous, arising from the upper and anterior part of the sternum, passes upwards and backwards, and meets the outer origin, which arises aponeurotic from the upper part of the sternal extremity of the clavicle,—a space being left between these two origins of a greater or less extent in different subjects, which is filled up with cellular membrane. The muscle then proceeds upwards and backwards to be *inserted* superiorly by thick aponeurotic fibres into the mastoid process of the temporal bone, and the external third of the superior transverse ridge of the occiput.

The sterno cleido mastoideus is covered by the deep cervical fascia and the platysma myoides: inferiorly it lies upon the sterno hyoid and thyroid muscles, and the sheath of the carotid artery and internal jugular vein; it crosses over the omo hyoideus, separated by it from the scalenus anticus muscle; and at its insertion it is immediately in contact, posteriorly, with the trachælo mastoideus, and anteriorly with the parotid gland.

Use.—To rotate the head in co-operation with other muscles; the sterno cleido mastoid of the left side, co-operates with the platisma myoides of the right, in performing the rotatory motion to the right; and *vice versa.* It also assists in violent inspiration, and is therefore to be considered as an antagonist to those muscles which depress the sternum. Its directions of action are downwards towards the sternum, and inwards towards the mesian line.

The muscles which are next to be dissected in the anterior region of the neck, are those which fix the os hyoides; they form a fixed point for the action of the muscles placed

between the os hyoides and lower jaw, which is necessary to enable them to open the mouth.

Four pairs of these muscles are placed below the os hyoides, between that bone and the trunk; but the fifth pair belong to the fourth class of the muscles on the anterior part of the neck, and are found placed between the styloid process of the temporal bone and os hyoides, for the purpose of preventing the os hyoides being tilted too much forwards by the action of the other muscles.

To commence this dissection, the sterno cleido mastoideus should be divided near its centre, and turned towards its attachments, when a narrow muscle will be seen passing vertically from the os hyoides to the sternum, called

The *m. sterno hyoideus.*—It *arises* inferiorly, by three distinct origins, from the back part of the sternum, from the posteror sterno clavicular ligament, and from the cartilage of the first rib; it then descends as a narrow band of muscular fibre, with a slight obliquity upwards and inwards, converging towards its fellow to be *inserted* into the lower edge of the body of the os hyoides. This muscle is covered by the deep fascia of the neck, and at its origin by the sterno cleido mastoideus; it covers the sterno thyroid, the crico thryroid and thyro hyoid muscles; and in passing in front of the larynx, a small bursa is usually found beneath it.

Use.—To depress the os hyoides and larynx, and secondarily assists in the depression of the lower jaw.

The *m. sterno thyroideus.*—This is brought into view by dividing the former muscle and reflecting it towards its attachments; it *arises* from the posterior and upper part of the sternum, rather to the inner side and with a broader origin than the sterno hyoideus, and also from the cartilage of the first rib; it then proceeds upwards to be *inserted* into an oblique line extending across the ala of the thyroid cartilage. This muscle is covered at its origin by the sterno cleido mastoideus; throughout its whole length it is behind the sterno hyoideus, but which does not entirely conceal it, in conse-

quence of its greater breadth; it is also enveloped by a process of the deep cervical fascia; at its origin it has behind it the internal jugular and subclavian veins, and on the right side also the arteria innominata: it then runs upwards upon the trachæa, and its outer edge partly overlaps the carotid sheath; it afterwards lies upon the thyroid gland and crico thyroideus muscle.

Use.—It depresses the os hyoides, larynx and thyroid cartilage; and by the motion which it gives to the latter, modifies the voice by stretching the vocal chords.

The *m. thyro hyoideus—arises* from the oblique line upon the ala of the thyroid cartilage, immediately above the insertion of the last described muscle, so as to appear continuous with it; and passes directly upwards to be *inserted* into the lower and outer edge of the base, and into the anterior half of the cornu of the os hyoides. This muscle is concealed by the sterno hyoideus and omo hyoideus muscles, and lies upon the thyroid cartilage and thyro hyoid ligament.

Use.—To draw the os hyoides downwards, and thus assist the sterno hyoid, thyroid and omo hyoid muscles in fixing it.

The *m. omo hyoideus*—a thin lengthened muscle, taking an oblique direction on the side of the neck; it *arises* from the superior costa of the scapula, near the proper notch of that bone, and from the ligament which passes across the notch to form it into a foramen; it then passes upward posterior to the clavicle, and crosses that triangular space which has been described as being formed by the clavicle inferiorly, and by the sterno mastoid and trapezius muscles laterally; at the posterior edge of the sterno mastoideus it becomes tendinous, and passes behind this muscle in a direction forming an acute angle with the clavicle; it again becomes fleshy as it approaches the outer edge of the sterno hyoideus: and now altering its direction, passes nearly vertically upwards to be *inserted* into the os hyoides, at the junction of its body with its cornea. This muscle at its

origin is deeply seated behind the clavicle, and is covered by the platysma myoides and the trapezius, then by the sterno cleido mastoideus: it crosses the scaleni muscles, the cervical nerves, the carotid sheath, the thyroid gland, and at its insertion is situated to the outer side of the sterno hyoid muscle: it receives a complete covering from the deep cervical fascia.

Use.—To lower the os hyoides, and direct it outwards and backwards, and also to assist in attaching the scapula to the trunk.

The last and fifth muscle which serves to fix the os hyoides, is

The *m. stylo hyoideus*—which *arises* by a short tendon from the base of the styloid process of the temporal bone, connected to it by a small bursa; it then passes downwards and forwards, in its course bifurcating so as to admit the tendon of the digastric muscle to pass through it; its fibres again unite to be *inserted* into the anterior part of the body of the os hyoides. This muscle is at first covered by the posterior belly of the digastricus; it crosses the carotid artery, jugular vein and lingual nerve; having on its inner side the stylo glossus and stylo pharyngeus muscles, and at its insertion lying upon the hyo glossus.

Use.—To draw the os hyoides upwards and backwards, to act as an antagonist to the muscles just described, and to assist in fixing the bone.

We may next proceed to those muscles which depress the lower jaw, and which are situated between the inferior maxillary bone and the os hyoides. This course of description is in exact consonance with the anatomical and physiological consideration of function.

The muscles situated between the lower jaw and os hyoides are four on either side of the median line, and are for the purpose of depressing the inferior maxillary bone when the os hyoides is fixed, or to raise that bone in the process of deglutition when the mouth is closed.

The *m. digastricus*, or *biventer maxillæ.*—This is the first muscle which presents itself to view. As its name implies, it

is composed of two fleshy portions: the *posterior* belly *arises*, broad and thick, from a depression on the inner side of the mastoid process of the temporal bone; it passes downwards and inwards towards the os hyoides, becoming thinner as it descends; and as it approaches that bone, it forms a small rounded tendon, which passes through the fibres of the stylo hyoideus muscle, and then becomes fixed to the os hyoides by a process of aponeurosis, which is given off from the tendon. From this point the *anterior* belly may be said to commence, which ascends, passing at the same time forwards and inwards, and becoming broader as it approaches the lower jaw, passes to be *inserted* by aponeurotic fibres into a fossa situated by the side of the symphysis.

The posterior portion of this muscle is partly covered by the three muscles which are inserted into the mastoid process of the temporal bone: namely, the sterno cleido mastoideus, trachelo mastoideus, and splenius; and the remaining part by the platysma myoides. It covers the three muscles arising from the styloid process of the temporal bone, crosses the carotid vessels, internal jugular vein, lingual nerve, hyo glossus, and mylo hyoideus muscles; and in the triangle formed by the two bellies of this muscle and the base of the lower jaw, the submaxillary gland is placed.

Use.—When both the bellies of this muscle act, the os hyoides being fixed, the lower jaw is depressed, and the mouth opened; if the anterior belly alone acts, it is for the purpose either of raising the os hyoides, and carrying it forwards, or for depressing the lower jaw, according with the bone that offers the fixed point for the action of the muscle; if the posterior belly alone acts, it either draws the os hyoides backwards, or, if that bone be fixed, it assists in raising the upper jaw, by drawing the head backwards.

The *m. mylo hyoideus.*—This muscle *arises*, by short tendinous fibres, from a line placed on the inner side of the lower jaw, extending from the last molar tooth to the centre of the inner surface of the symphysis, where the muscle meets with its fellow on the opposite side, and they unite sometimes fleshy, and at others by a small tendinous rapha; it then passes downwards and backwards to be *inserted* ten-

dinous into the fore part of the os hyoides; its anterior fibres being shorter than the posterior, which pass from one bone to the other in nearly a vertical direction.

The cutaneous, or under surface of the mylo hyoideus, has in contact with it the platysma myoides, the anterior belly of the digastricus, and the submaxillary gland. The upper, or lingual surface, covers the genio hyoideus, genio hyo glossus, and hyo glossus muscle; the sublingual gland, duct of the submaxillary gland, lingual, and lingual gustatory nerves.

Use.—One of these muscles seems scarcely capable of action without its fellow; they are together for the purpose of depressing the lower jaw, or of raising and drawing forwards the os hyoides, and parts attached to it, pushing the tongue upwards towards the palate.

The *m. genio hyoideus*—*arises* by strong and short tendinous fibres, from a small tubercle situated in the inner surface of the symphysis of the lower jaw; gradually becoming thicker and broader, it passes downwards and backwards, to be *inserted* into the anterior surface of the body of the os hyoides. Its cutaneous, or under surface, is covered by the mylo hyoideus muscle; its posterior, or upper surface, is in contact with the genio hyo glossus, and its inner surface with its fellow.

Use.—The genio hyoideus muscle assists either in depressing the lower jaw, when it acts with the sterno hyoideus, of which it seems as a continuation; or in elevating the os hyoides.

The *m. genio hyo glossus.*—This muscle may be divided into two portions; its genio hyoideal, and its genio glossal fibres; the former is that portion which is now to be described as assisting in the function of those muscles which depress the lower jaw, or raise the os hyoides; it takes precisely the same course from the symphysis of the jaw to the os hyoides, as the last described muscle, its under surface being in contact with that muscle; its inner surface, with its fellow, and its upper, being contiguous with its genio glossal fibres; which portion of this muscle will be described with the muscles proper to the tongue.

The *use* of this part of the muscle is the same precisely as the genio hyoideus. The lower jaw, by this last set of muscles, being depressed, it may be well to consider the mouth opened, for the purpose of taking in food, that we may be enabled physiologically to describe the muscles as they present themselves to view in this dissection, according to the function they are destined to perform in the process of mastication and deglutition: and first of these the four muscles of mastication, or those which raise the lower jaw, and close the mouth.

Before describing the origin and insertion of the temporal muscle, its aponeurotic covering must be spoken of. This aponeurosis arises upon the lateral surface of the skull, from a white arched line, which extends on the frontal parietal and temporal bones; or may be considered as a continuation of the epicranial fascia: it proceeds downwards to the zygomatic arch, and is attached to the whole length of its upper border, in its course splitting into two portions, the inner of which passes between the fibres of the temporal muscle, so as to divide them into a superficial and deep set, the superficial being the most attenuated.

The *m. temporalis—arises* from the inner surface of the temporal fascia, and from the whole length of the white arched line which extends over the frontal, parietal and temporal bones, forming the boundary of the temporal fossa; from these points of origin the fibres pass downwards, converging as from the circumference to the centre of a circle, and opposite the zygomatic arch, terminating in a very strong tendon, which descends vertically to the coronoid process of the lower jaw, into the whole of which it is *inserted.* The external surface of this muscle is fleshy, the internal tendinous, and particularly at the lower part, just as it is passing to be inserted. The temporal muscle is covered externally by its aponeurosis, by the anterior and levator muscles of the ear, which arise from the temporal fascia, and also by the zygomatic arch; its internal surface covers first the temporal fossa formed by the bones of the head, the pterygoideus externus muscle being only separated from it by fat, and the internal maxillary artery. The anterior fibres of this muscle, which pass from the frontal temporal fossa, are on a plane,

deeper seated than the posterior, or zygomatic fibres, as they are directed to the coronoid process.

Use.—To draw the lower jaw upwards and backwards, and to press the teeth of the two jaws together. If the posterior fibres of this muscle alone act, they have, in a slight degree, the power to depress the lower jaw, and open the mouth; which being completed, places the anterior fibres in the best possible position to close the mouth again, both by depressing the head, and elevating the jaw.

The *m. masseter*—*arises* from the two anterior thirds of the inferior edge of the zygoma. The posterior fibres of this muscle are aponeurotic, pass in a direction from above downwards, and from behind forwards, forming a strong external tendinous surface to this portion. The anterior fibres are fleshy, passing from before backwards towards the lower jaw, are the most internally situated, so that the fibres of these two origins decussate and pass to be *inserted* into the base of the lower jaw, in a space between its angle and the origin of the depressor anguli oris. The external surface of the masseter is covered partly by the parotid gland, and is traversed by its excretory duct; it is also covered by the platysma myoides, branches of the fascial nerve, and temporal artery: its internal surface covers the ramus of the lower jaw, the insertion of the temporal muscle and the buccinator, from which it is separated by a large quantity of fat.

Use.—When both of its layers act, to raise the lower jaw, which it effects to a great advantage, from the obliquity and decussation of its fibres; but when they act separately, the jaw is drawn alternately backwards and forwards, so as to grind the teeth together: it is, therefore, one of the most important muscles in mastication.

The best mode of exposing the pterygoid muscles, is to saw through the neck of the lower jaw, and through the base, just at the anterior edge of the masseter muscle, and thus to remove the whole of the ascending ramus.

The *m. pterygoideus internus*—*arises,* strong and tendinous, from the fossa between the external and internal roots of the pterygoid process of the sphenoid bone, and from the pterygoid process of the os palati; it then becomes fleshy, and passes obliquely downwards from behind to before, to be *inserted*

into the inner side of the angle of the inferior maxillary bone, in a similar manner to the insertion of the masseter on the outer side of the angle of the same bone; the tendons of the two uniting underneath, form a kind of sling for the reception of the lower jaw. This muscle is covered by the ascending ramus of the lower jaw; it is separated from the pterygoideus externus, by the internal maxillary artery, the lingual gustatory nerve, and cellular membrane; and along its posterior edge, the internal lateral ligament passes from the styloid process to the angle of the jaw.

Use.—When one of these muscles acts, it draws the lower jaw obliquely to the opposite side; when both act, they raise the lower jaw, and close the mouth; and if they act when the superior and inferior maxillary bones are in contact, they incline the head slightly backwards.

The *m. pterygoideus externus—arises* from the external root of the pterygoid process of the sphenoid bone, from the root of the temporal process of the same bone, and also from the tuberosity of the os maxillare superius, adjoining the pterygoid process of the sphenoid; at this point being connected with the buccinator, and superior constrictor of the pharynx: from these several origins its fibres pass backwards and outwards almost transversely, to be inserted into a fossa in the condyloid process of the lower jaw, and into the ligament which surrounds the articulation of this bone with the temporal. This muscle, like the pterygoideus internus, is covered by the ramus of the lower jaw and muscles of the face.

Use.—When this muscle acts singly, the jaw is directed forwards, and to the opposite side; when both muscles act, the jaw is moved horizontally forwards.

These four muscles are most especially employed in the process of mastication; the action of the temporal and masseter preponderates in the preparation of animal food for deglutition; whilst the pterygoid muscles, from the peculiar motions they give to the lower jaw, are best adapted to break down and triturate vegetable matter; so that the

comparative development of these muscles forms a distinguishing mark between carnivorous and graminivorous feeders. In man, who is termed omnivorous, these four pairs of muscles being equally developed, all kinds of food are thoroughly prepared by them for deglutition. We may now take into consideration those muscles which are destined to collect and form the masticated food into a bolus, for the purpose of its being passed into the fauces; this office is performed by the

Muscles of the Tongue.

The tongue is composed of muscle, and is covered by mucous membrane; it is attached behind to the os hyoides by a broad base, while anteriorly it is narrow and pointed, and capable of being turned and twisted in every direction, to enable it to collect the food, and perfectly mix it with the secretions of the mouth. The tongue, although it has all the appearance of a single organ, yet might with propriety be considered a double one, being furnished with a central rapha, and perfectly symmetrical organized sides, which are, in a great measure, independent of each other. This may be frequently seen in hemiplegia, where one side has completely lost its power of function, while the other remains perfect. The principal bulk of the tongue is made up of four pairs of muscle, which are placed in the following order, and are to be dissected by dividing the jaw at the symphysis, and by drawing the tongue forcibly forwards out of the mouth; thus bringing into view, first,

The *m. genio hyo glossus.*—The anterior fibres, or genio hyoideal portion of this muscle have already been described as acting solely with those placed between the os hyoides and lower jaw; but the genio glossal portion, or posterior fibres, are now to be considered, as belonging especially to the tongue. They *arise* from a protuberance on the inner surface of the symphysis of the lower jaw, above the origin of the genio hyoideus; from this, as from a centre, the fibres radiate, passing forwards to the tip, upwards to the centre,

and backwards to the base of the tongue, forming thus the inner boundary of each half. The posterior fibres send off a delicate tendinous fasciculus to the os hyoides, which passes to be indirectly connected with the base of the epiglottis.

This muscle is bounded inferiorly by the genio hyoideus, superiorly by the mucous membrane of the mouth, externally by the sublingual gland, the lingualis, and hyo glossus muscles; internally it is firmly connected with its fellow by strong condensed cellular tissue forming the rapha.

Use.—All the fibres of this muscle assist in pushing the tongue out of the mouth, the anterior fibres draw it back again, while the middle fibres render the dorsum of the tongue concave, the fasciculus, which passes to be attached to the base of the epiglottis, pulls that fibro cartilage forwards and upwards.

The *m. lingualis,*—as its name would imply, is only attached to the tongue; *arising* from the base of that organ, it proceeds forwards to the tip, in which it may be said to be *inserted.* It has to its inner side, along its whole length, the genio hyo glossus. On its outer side, for the posterior two thirds, the hyo glossus; and on the anterior third, the stylo glossus muscle: above and below it is in contact with the mucous membrane of the mouth, and its fibres are intimately connected with the muscles which bound them laterally.

Use.—To shorten the tongue, and direct the tip towards the frænum linguæ, and floor of the mouth.

The *m. hyo glossus—arises* from the os hyoides by three separate fasciculi, in such a manner as to have been described by Albinus as three distinct muscles, bearing each a distinct name, according to their attachments; it may, however, with propriety be described as one muscle, *arising* from the outer half of the base, and part of the cornu of the os hyoides, passing upwards to be *inserted* into the posterior two thirds of the tongue.

The under surface of this muscle, at its hyoideal attachment, is covered by the mylo hyoideus, stylo hyoideus, and digastricus muscles; as it proceeds towards the tongue, by the lingual and lingual gustatory nerves, submaxillary gland, and excretory duct; at its insertion it is placed between

the stylo glossus on the outer side, and the lingualis on the inner; above it is covered by the mucous membrane of the mouth; and some few of its fibres are connected with the middle constrictor of the pharynx, at its hyoideal attachment.

Use.—When one muscle acts, it depresses the base of the tongue, obliquely drawing it to one side: when both act, it either depresses the whole base, or raises the os hyoides if the tongue be fixed.

The *m. stylo glossus—arises,* thin and tendinous, from the apex of the styloid process of the temporal bone, below and in front of the stylo hyoideus muscle, and also from the stylo maxillary ligament; it then descends, becoming broader and thinner, to be *inserted* into the whole length of the outer edge of the tongue.

This muscle is bounded externally by the digastric muscle, lingual nerve, and mucous membrane of the tongue; internally, by the superior constrictor of the pharynx; by the hyo glossus muscle posteriorily, and the lingualis anteriorly.

Use.—To carry the tongue upwards, backwards, and obliquely to one side, when acting singly: but when both act, they direct the tip of the tongue to the roof of the mouth, and contract both its longitudinal and lateral dimensions.

The next part called into action in the function of deglutition; under which consideration I have classed the muscles of the tongue; is the fauces, which is a narrowed arched canal, connecting the posterior part of the mouth with the pharynx. It is bounded below, by the base of the tongue; above, by a soft muscular moveable curtain, which is termed the velum pendulum palati; and on either side by two pillars; the anterior of which is termed the constrictor isthmi faucium; the posterior, the palato pharyngeus; which, in their descent, diverge, so as to admit the tonsil gland between them. From the centre of the velum pendulum palati, a soft triangular portion falls down in the middle line, so as in some measure to divide the opening of the fauces into two passages: this process, which is muscular, is termed the uvula. All these parts are covered by a continuation of the mucous membrane of the mouth, which must be removed, to expose the muscles of the fauces

of the soft palate, and the muscles which move the soft palate.

It will facilitate the dissection of the muscles of these parts, to bear in mind, that the constrictor isthmi faucium, palato pharyngeus, and azygos uvulæ, are common to the fauces and velum pendulum palati, and that the circumflexus and levator palati are proper to the soft palate.

The *m. constrictor isthmi faucium*, or *glosso staphylinus*—*arises*, by thin and slender fibres, from the sides of the root of the tongue; it ascends in the form of an arch in front of the tonsil; and in the middle line, at the posterior edge of the palatine processes of the palate bones it *joins* with its fellow, and with the palato pharyngeus muscle, to form the velum pendulum palati, sending fibres down into the uvula. This muscle below is bounded by the tongue, above by the soft palate, on its outer side by the insertions of the circumflexus and levator palati, and on its inner by its fellow: both its surfaces are covered by mucous membrane, and it has the tonsil situated immediately behind it.

Use.—To draw the soft palate towards the tongue, and consequently contracts the opening of the fauces; and when the soft palate is fixed by the tensores palati, then the constrictor isthmi faucium raises the tongue.

The *m. palato pharyngeus*, or *pharyngo staphylinus*—*arises* from the lateral parietes of the pharynx, in common with the superior and middle constrictors, where they are connected with the thyroid cartilage; from this origin the fibres pass upward behind the tonsil, forming the posterior pillar of the fauces; it then directs itself inwards towards the posterior edge of the palatine vault; dividing however into two layers, and admitting the tendon of the tensor palati between them, the muscle then joins its fellow of the opposite side, the constrictor isthmi faucium, and uvula, completing the velum palati. The situation of the muscle is sufficiently described in speaking of its attachments.

Use.—To lower the velum pendulum palati, or to raise and shorten the pharynx: it acts principally in deglutition.

The *m. azygos uvulæ,* or *levator uvulæ,* or *palato staphalinus*—is a small elongated muscle, which *arises* from the extremity of the nasal spine of the palate bones, and from the tendons of the tensores palati; its fibres being also connected with the palato pharyngeus, passes down the whole length of the uvula, to be *inserted* into its tip.

This muscle is not always single, but sometimes forms two distinct lateral fasiculi.

Use.—To raise the uvula, make it shorter, and curve it forward.

The muscles which act upon this muscular curtain, so as to render it capable of preventing the food passing in any other direction than into the pharynx, are the tensor and levator palati.

The m. circumflexus palati, tensor palati, or *pterygo staphylinus*—*arises,* principally tendinous, from the extremity of the spinous process of the sphenoid bone, posterior to the foramen spinosum, and also from the fibro cartilaginous tissue of the eustachian tube; it then takes its course downwards, forwards and slightly inwards, along the posterior edge of the pterygoideus internus muscle, as far as the extremity of the internal pterygoid lamella of the sphenoid bone, and there it becomes tendinous, alters its course, winding around the hamillary process of that bone, and being furnished there with a bursa mucosa, it is then reflected upwards and inwards, and spreads itself into a broad tendinous expansion, to be *inserted* into the velum pendulum palati; its fibres emerging with those of the palato pharyngeus and superior constrictor of the pharynx.

This muscle is situated in front, and below the eustachian tube, immediately behind the foramen spinosum, and consequently the spheno spinal artery, which passes through that foramen to the dura mater.

Use.—To draw the soft palate very slightly downwards, but principally to stretch it, by drawing it outwards.

The *m. levator palati mollis,* or *petro staphylinus*—*arises* from the anterior extremity of the petrous portion of the temporal bone, and from the eustachian tube; from these

points it is directed downwards and inwards, passing between the occipital and sphenoidal origins of the superior constrictor of the pharynx, it is *inserted* into the whole length of the velum, as far as the azygos uvulæ. The two muscles in the median line are so intimately connected with each other, as to form an arch, the convexity of which is directed downwards, and rests upon the palato pharyngeus muscles.

This muscle is situated behind and above the eustachian tube, which is found between this and the last described muscle.

Use.—To raise the soft palate, bringing it on a plane with the roof of the mouth; so as to cut off the communication between the upper part of the pharynx, into which the nares and eustachian tubes open; from the lower part, which leads into the œsophagus.

The narrow opening leading from the mouth to the pharynx, is termed the isthmus faucium, which may be either enlarged or contracted by the action of the five pairs of muscles which have been just described. It is by the different motions of the soft palate, which forms the upper boundary of this passage, that the food is directed into the pharynx; that inspired air is led into the glottis; or that expired air is forced partly through the nostrils, or into the cavity of the tympanum: hence at once it is clear, from this consideration, that this part has most important and very different functions to perform, and requires therefore a complicated and perfect organization to render it efficient to its several offices. In looking into the posterior part of the mouth, the uvula is seen hanging down from the centre of the velum pendulum palati; to this little body may be adjudged the peculiar power of preparing the whole apparatus for the next office to be performed, it may indeed be considered as the centinel which regulates the direction of the substances which are intended to be swallowed or ejected, and of the air which is either to be inspired or expired; and at the same time keeping the parts in such reciprocal action, that the function of respiration should not be suspended during the

process of deglutition. To effect this multiplied action, we find the uvula connected with, or may indeed be said to be made up of all the muscles of the velum. Hence it is, as we frequently find in disease, that any loss of substance to this part interferes with these functions; that the food passes into the nostrils, and that the voice also becomes altered and unnatural.

Both for the purposes of deglutition and respiration, it is necessary for this narrow passage to be constantly lubricated by mucous: we find, therefore, a large gland on either side the isthmus, placed under the influence of the two muscles which form the pillars of the fauces, and which compress the secretion from this gland at the very time it is most required, while the food is passing; and it is further supposed by some physiologists, that the uvula assists in lubricating the pharynx, not only by its enlarged surface of mucous membrane, but also by directing the secretion of the tonsil gland into the middle line of the fauces and pharynx. The food having now been masticated, mixed with the saliva, and formed into a bolus by the motions of the tongue, is forced through the isthmus faucium by the constrictors of the fauces into a membranous muscular sac, which is termed the pharynx. The term sac, however, is not quite appropriate to its form, as will be found from a careful examination of the part. The posterior wall of the pharynx is made up of three flat muscles, which are contiguous, but nevertheless lie on different planes with respect to each other; the one is superior, and at the same time anterior; the second intermediate, whilst the inferior is upon a plane posterior to both. This muscular wall, first considering it as one muscle, *reaches* from the cuneiform process of the occipital bone, to the cricoid cartilage of the larynx, being of a funnel-shaped form, larger above than it is below; it is bounded *posteriorly* by the longus colli muscle, and the three superior cervical vertebræ; *anteriorly* it is formed by other organs into a canal, which has led me to say it is not appropriately called a sac; it opens above into the nose; into

the eustachian tubes; then into the mouth, through the medium of the fauces; lower down into the larynx, through the glottis; and, lastly, to its termination, where it is successively bounded by the os hyoides, thyroid, and cricoid cartilages of the larynx: but each of the openings, as has been before mentioned, are capable of being closed or opened by the action of the muscles of the fauces. *Laterally* the pharynx is bounded by the petrous portions of the temporal bones, the pterygoid processes of the sphenoid, the two jaws behind their molar teeth, the tongue, the cornua of the os hyoides, and lastly, the lateral parts of the thyroid and cricoid cartilages. Besides this muscular posterior parietes to the pharynx, there are two small muscles laterally placed, which pass from the styloid processes of the temporal bones, and which serve to keep the pharynx, during deglutition, in the best position to receive the food from the fauces.

Having taken this general view of the pharynx, the muscles should now be dissected, by cutting through the trachæa, and turning the larynx and pharynx upwards; or they may be still better displayed, by removing the head from the body: in either case, they must be dissected from behind, and consequently it is the lower portion of the muscle, which has already been described as most posterior, which first comes into view; this is termed

The *m. constrictor pharyngis inferior.*—This is the longest of the muscles of the pharynx; it is broad, and irregularly quadrilateral; *arises* from the sides of the cricoid cartilage, near the crico thyroideus muscle, from the alæ of the thyroid cartilage, immediately behind the thyro hyoideus muscle: from these origins its fibres pass upwards and backwards to be *inserted* into the mesian line, by uniting with its fellow, and forming a rapha; its superior fibres are long, and pass nearly vertically, so as to form a very acute angle with those of the opposite side; the inferior are short, and run transversely along the posterior part of the lower edge of the cricoid cartilage, to be connected with the upper part of the œsophagus.

This muscle rests upon the rectus capitis anticus major and longus colli muscles, and its anterior surface is covered by the middle constrictor of the pharynx,

The *m. constrictor pharyngis medius.*—This muscle *arises* from the superior part of the cornua of the os hyoides, reaching as far anteriorly as the appendix; it also arises from the thyro hyoid ligament, its superior fibres pass upwards with great obliquity to be *inserted* into the cuneiform process of the occipital bone, while the rest of its fibres pass more inwards, to meet corresponding fibres of the muscle on the opposite side, and form a rapha, covering the posterior surface of the superior constrictor. The lower part of this muscle posteriorly is covered by the last described muscle, while above it covers the inferior fibres of the constrictor pharyngis superior.

The *m. constrictor pharyngis superior.*—This muscle *arises* above from the cuneiform process of the occipital bone, anterior to the insertion of the middle constrictor, in front of the foramen magnum; it also arises from the pterygoid process of the sphenoid bone, from the superior and inferior maxillary bones behind the dentes sapientiæ, being here connected with the buccinator muscle, and from the sides of the base of the tongue, between the stylo and hyo glossus muscles. The fibres proceed in a transverse direction, to be *inserted* by interlacing with those of the opposite side, and form a rapha in the middle of its posterior surface.

The largest part of this muscle posteriorly is covered by the middle constrictor; anteriorly it is covered by the mucous membrane of the alimentary canal, and is bounded by the openings of the nares, eustachian tubes, and glottis.

Use of these muscles. The whole of the fibres serve to contract the pharynx, but that part of the muscle only contracts which is stimulated by the presence of the food: the middle constrictor also raises the os hyoides, and the larynx thereby shortening the canal, and at the same time drawing the tongue upwards and backwards, assists in closing the glottis; the inferior constrictor raises the larynx, and draws the œsophagus upwards.

The *m. stylo pharyngeus.*—This muscle *arises,* by a thin

tendon, from the inner side of the base of the styloid process of the temporal bone; it passes downwards and backwards to be *inserted* into the side of the pharynx, sending some fibres to the os hyoides and thyroid cartilage, and mingling with those of the palato pharyngeus muscle.

This muscle is deeply seated, its origin being covered by the stylo hyoideus and stylo glossus muscles, and its insertion, by the middle constrictor of the pharynx.

Use.—To raise the pharynx, and at the same time to widen it, and render it better capable of receiving the food. This muscle in its dissection may be classified as one of the three muscles arising from the styloid process, and being situated transversely between the os hyoides and lower jaw; but then its situation alone would be learnt, and not its function, which should always be the paramount consideration.

From the pharynx the ingesta pass into the œsophagus, an organ which will be described with those of digestion.

Practical Remarks.

The neck has been already described, as that part of the body which is situated between the chest and head. From the numerous and important parts which are connected with it, such are the organs of deglution, respiration, large arteries, veins, and nerves, &c., the wounds of this part require a treatment at once ready and efficient, and such as can only be recommended by a surgeon, who, familiar with the anatomy and physiology of all the structures, is at first view capable of forming a just opinion as to the necessary means to be employed for the relief of the patient.

To simplify these considerations, the neck should be divided into four regions; an anterior, two lateral, and a posterior region.

The anterior region is triangular, and is bounded above by the lower jaw, reaching as far laterally as the mastoid processes of the temporal bones, below by the sternum forming the apex of the triangle, and laterally by the two anterior edges of the sterno cleido mastoidei muscles. This space should be subdivided into thirds, the upper third between the os hyoides and the lower jaw: the middle third between the os hyoides and the cricoid cartilage; and the lower third between the cricoid cartilage and the sternum. In a surgical point of view, wounds of the upper third are the least important; of the middle third, of greater; and of the lower third, of the greatest importance; for the following reasons. Wounds of the upper third would divide chiefly muscular parts, without leading to much apprehension from hæmorrhage, in conse-

quence of the comparative smallness of the vessels of this region; if the incision be carried deeper, the pharynx is laid open, which is indicated by the flow of mucous from the wound, and sometimes also saliva, if the excretory duct of a salivary gland be divided; if the wound of this region be extended outwards, the cutting instrument would pass into the digastric triangle, which is comprehended between the symphysis of the lower jaw, the mastoid process of the temporal bone, and the junction of the digastric tendon with the os hyoides; in which space the facial vein, submaxillary gland, facial artery, and lingual nerve, are in danger of being wounded. These occurrences would be rendered obvious by a flow of venous blood, of saliva, of arterial blood, and a paralysis of the tongue. In either case, or in a complication of them, the object of the surgeon would be to stop severe hæmorrhage, to bring the divided parts into close adaptation with sutures, and by the position of the head, to secure the parts from the disturbances of motion. This is effected by bringing the head forwards, drawing the chin towards the sternum, and carefully securing it with bandages in that position. A wound into the upper part of the middle third of the neck, may divide, besides the muscles, the superior thyroideal artery, which would be indicated by hæmorrhage; it may open the pharynx, by cutting through the thyro hyoideal ligament, which would be evinced by the escape of the contents of that organ; below this, it may open the larynx by the division of the thyroid cartilage, shown by the escape of air; still, however, with the retention of voice: if at the lower part of the middle third the larynx be opened by an incision between the thyroid and cricoid cartilages, at the same time wounding the thyroid gland, this accident would be obvious, from the frequent and forcible expulsion of air, blood, and frothy mucous though the wound, but unattended with voice, in consequence of the opening being below the vocal chords. The wound may also extend so far backwards as to open the pharynx, which would be shewn by the escape of saliva and mucous. The treatment in these accidents is the same as in wounds of the upper region.

Wounds of the inferior third would divide the trachæa, the œsophagus, and as happen, in most instances, the jugular vein and carotid artery, from their greater proximity to the anterior surface of this division of the neck: if the incision be made very deeply, the par vagum may also be divided. These parts may indeed be wounded by a deep incision in the middle division; but from their greater depth, and the protection afforded them by the firm cartilages of the larynx, they are in that situation less liable to injury. In division of the trachæa and œsophagus only, the divided parts are to be brought into close adaptation, and treated as before. When the large blood-vessels

are divided, the sudden and great loss of blood has generally destroyed life before surgical aid could be attained; but should not life be extinct, may not such accidents offer fair opportunity for the trial of transfusion of blood, as the best chance of restoring the patient.

It may be well here to remark, that in operations of the anterior region of the neck, the anterior edges of the sterno cleido mastoidei form a general direction to the course of the common and external carotid arteries. Again, with regard to operations of this region, there is no part of the body in which position is of greater importance, as the elevation or depression of the head and lower jaw alter materially the relative position of the larynx and os hyoides. This may be exemplified by the measurement of the elevation and depression of the thyroid cartilage and os hyoides in various subjects, and should be observed with regard to each individual subjected to operation.

The lateral regions of the neck are comprehended in an irregular triangle, the base of which is formed by the middle third of the clavicle, the apex immediately below the mastoid process of the temporal bone, anteriorily bounded by the posterior edge of the sterno cleido mastoideus, and posteriorly by the anterior edge of the trapezius. The whole of this space is covered by the platysma myoides muscle, which is necessary to mention, from its relation to the operation of bleeding in the external jugular vein. The external jugular vein lies immediately under the platysma myoides upon the sterno cleido mastoideus; the opening of this vein differs from bleeding elsewhere, as we necessarily puncture it through muscular fibre, the contraction of which the surgeon has to contend against. Having described the platysma myoides, and its relation to the external jugular vein, we will now proceed to the subdivision of this lateral region into two spaces, each of them of a triangular form. The lowest of these two spaces is bounded in front by the posterior edge of the sterno cleido mastoideus and external jugular vein; below, by the clavicle; above, by the omo hyoideus, and behind, the triangle terminates, where the omo hyoideus crosses behind the trapezius muscle. This space is rendered of great consequence, from the numerous parts and important surgical operations connected with it. It is within this triangle that a ligature may be placed around the subclavian artery for axillary aneurism, an operation rendered difficult from the smallness and depth of the space, which includes on the inner side of the artery the scalenus anticus muscle; on the outer side, the nerves joining to form the axillary plexus: and in front the subclavian vein traversing the lower portion of the artery immediately above the clavicle. The experienced anatomist readily avoids these difficulties, by making the outer edge of the scalenus muscle his guide

to the artery, which lies immediately beneath it, on the first rib, and cannot with safety be tied until the edge of this muscle is *distinctly* exposed.

In that portion comprehended above the omo hyoideus muscle, the parts are of much less surgical importance; in it may principally be remarked the numerous superficial branches of the cervical nerves. The posterior cervical region is comprehended between the protuberance of the occiput above, the outer edges of the trapezii laterally, and a line drawn from the acromion of the scapula of one side to the other. This space is not rendered of much surgical importance, excepting from the aponeurotic covering which lies immediately underneath the common integument. This part, possessing such little vitality, has a tendency to run into suppuration, and is the reason of the danger attending carbuncle in this situation.

LECTURE XV.

DESCRIPTIVE ANATOMY OF MUSCLES.

Muscles of the Upper Extremity.

It is here necessary to give the reason why the muscles of the upper extremity should follow before I have finished the description of the muscles of the neck. Had we proceeded, in continuation of the descriptive anatomy of the muscles deeply seated in the neck, we must of necessity have removed those muscles of the upper extremity, as they cover the deep-seated muscles of the posterior cervical region; and the student could not have continued this progress of dissection without the destruction of that part of the body. Also, the muscles of the neck not yet described, may with greater propriety be considered separately, as they are not connected with the functions of deglutition and mastication, as those already described.

The muscles of the upper extremity are divided into those which attach the scapula to the trunk; those which move the shoulder-joint; those of the elbow-joint; the muscles of the radio ulnar articulations; muscles of the wrist joint; those common to the fingers; those proper to the fingers; and, lastly, the muscle of the palmar fascia. The muscles which attach the scapula to the trunk are seven in number, although, if we consider the subclavius muscle as assisting in this attachment, it will make the number eight. They are situated, in relation to the scapula, in the following order:—two above, three behind, and three in front; enumerating the subclavius, which is, however, frequently considered as a muscle proper to the clavicle.

The three muscles situated behind the scapula should be

the first dissected, as the muscles above the scapula cannot be exposed until they are removed.

The *m. trapezius.*—This muscle *arises* aponeurotic from the middle of the superior transverse arch and protuberance of the os occipitis, from the ligamentum nuchæ, and from the spinous process of the seventh cervical, and all the dorsal vertebræ; from these different origins the superior fibres pass downwards and outwards, to be *inserted* into the outer third of the clavicle; the middle fibres pass transversely outwards, to be *inserted* into the spine of the scapula; and the inferior fibres pass upwards, reaching as far as the acromion process, into which they are *inserted.*

This is the most superficial muscle of the posterior part of the trunk, and is consequently covered by skin, being firmly connected to it by a dense fascia: it covers on the back the complexus, splenius, levator scapulæ, rhomboidei, and part of the latissimus dorsi muscles; on the scapula it covers the supra and infra spinati, and along the spine has its tendinous insertion connected with the origin of the deltoid. In the whole length of its origin it is connected with its fellow; the clavicular insertion of this muscle is also connected with the deltoid muscle, as on the spine of the scapula.

Use.—When the whole of the muscle acts, it draws the clavicle and scapula backwards, the superior fibres raise the clavicle and scapula upwards as well as backwards, the middle fibres approximate the scapulæ, and the inferior fibres draw the scapulæ downwards. The scapulæ being fixed, the trapezii extend the head; or, if only one muscle acts, it draws it to one side.

The *m. rhomboideus major.*—This muscle *arises,* by aponeurosis, from the lateral part of the extremities of the spinous processes of the five superior dorsal vertebræ; and from the interspinal ligaments, it soon becomes broad and fleshy, and passes in a direction downwards and outwards, to be *inserted* into that portion of the posterior costa of the scapula below the spine, sometimes reaching to the inferior angle. The rhomboideus major muscle is covered partly by the trapezius and partly by the latissimus dorsi; a small

portion being seen between these muscles, and the inferior part of the base of the scapula.

Use.—To draw the scapula backwards, and at the same time the inferior angle upwards, which directs the anterior angle and glenoid cavity forward.

The *m. rhomboideus minor.*—This muscle *arises* from the sides of the apices of the sixth and seventh cervical vertebræ, and from the termination of the ligamentum nuchæ; its fibres then pass downwards to be *inserted* into the posterior costa of the scapula, above the spine. This muscle is inserted immediately below the levator scapulæ; in other respects it is situated the same as the rhomboideus major, the two being sometimes described as one muscle.

Use.—To draw the scapula obliquely upwards and inwards.

The two muscles which fix the scapula above, are the omo hyoideus and the levator scapulæ; the origin and insertion of the former has already been described, having been classified with those muscles which serve to fix the os hyoides; but as it does also assist in raising the scapula, it is necessary now to name it, without however recapitulating its origin and insertion.

The *m. levator scapulæ.*—This muscle *arises* by five distinct tendinous origins from the transverse processes of the five superior cervical vertebræ, but more frequently only from the three superior; these tendinous origins pass downwards, and soon become distinct fleshy bundles, which unite below, forming one muscle, to be *inserted* fleshy into the posterior part of the superior angle of the scapula. The five origins of this muscle are anteriorly covered by the sterno cleido mastoideus, more deeply by the scalenus medius muscle, posteriorly by the trapezius and splenius capitis, and still deeper by the splenius colli: the insertion of the levator scapulæ has the origin of the omo hyoideus in front of it, the rhomboideus minor behind it, the supra spinatus below it, and is covered by the trapezius.

Use.—To draw the scapula upwards and slightly forwards, or, if the scapula be fixed, it inclines the neck to its side.

The three muscles attaching the scapula to the anterior

part of the trunk, are the pectoralis minor, serratus magnus, and subclavius.

The *m. pectoralis minor.*—This muscle *arises,* tendinous and fleshy, from the external surface of the third, fourth, and fifth ribs ; the fibres then converge, pass upwards and outwards, to be *inserted* into the inner side of the apex of the coracoid process of the scapula.

This muscle is covered by the pectoralis major, while on the chest ; but in passing from the thorax to the coracoid process it is covered by the deltoid muscle, and at its insertion into this process it has the subclavius to its inner side, and the coraco brachialis muscle on its outer.

Use.—To draw the coracoid process and scapula downwards and forwards upon the chest ; but when the scapula is fixed, it then becomes a muscle of inspiration, by raising the ribs, and acting as an antagonist to the sterno costalis muscle.

The *m. subclavius.*—This muscle *arises* tendinous from the cartilage of the first rib, where it is connected with the sternum ; from this origin it passes outwards and slightly upwards, along the inferior surface of the clavicle, as far as the coracoid process, into which it is *inserted,* as well as into the conoid ligament, which connects the clavicle with that process. This muscle is surrounded by the fascia cervicalis profunda, and is situated between the sternum and scapula ; it is bounded above by the omo hyoideus, below by the pectoralis minor, a considerable space being between the two, in which the subclavian artery and vein may be seen. Anteriorily it is covered by the pectoralis major, and posterior to it, are placed the subclavian artery, vein, and axillary plexus.

Use.—To draw the scapula and clavicle downwards upon the chest ; or if the shoulder be fixed, it raises the first rib and sternum, assisting in inspiration.

The *m. serratus magnus.*—This muscle *arises* by nine distinct digitations, from the nine superior ribs : they form the muscle into distinct fasciculi, which pass backwards to be *inserted* into the internal margin of the base, or posterior costa of the scapula, from the superior to the inferior angle, to

both of which it is attached. The serratus muscle is situated between the ribs and the scapula. It covers the eight superior ribs, and their intercostal muscles, being itself covered below by the latissimus dorsi, and above by the subscapularis; its fleshy digitations are of unequal length, the superior being shorter and thicker, while the inferior are longer and thinner, and are connected with the m. obliquus abdominis externus.

Having described the seven muscles connecting the scapula to the trunk, there are yet two muscles which must be dissected before we can detach the upper extremity, and which properly follow now in the order of dissection, as they belong to the set of muscles next to be described.

The muscles of the shoulder joint are nine in number; two arising from the trunk, to be inserted into the os humeri, and seven from the scapula, likewise to be inserted into the os humeri.

The *m. pectoralis major.*—It *arises* tendinous from the sternal half of the clavicle, tendinous from the whole anterior surface of the sternum, fleshy from the cartilages of all the true ribs; and, lastly from an aponeurosis common to it and the external abdominal oblique and rectus muscles. From this extended origin, its fleshy fibres converge, passing across the breast to be *inserted* by a broad flat tendon into the os humeri, attached to the outer edge of the groove which lodges the tendon of the long head of the biceps.

The clavicular portion of this muscle is separated from the commencement of the sternal origin by an intermediate space between its fibres, which is filled up by condensed cellular membrane; this is a space of considerable surgical importance, as behind it, is placed the subclavian artery and vein, covered by the coraco costal ligament. The pectoralis major is superficially situated upon the chest, being only covered anteriorly by the skin and platysma myoides and mamma; it covers the inner half of the clavicle, the anterior surface of the sternum, and the cartilages of the true ribs, the internal intercostal muscles, the serratus magnus, pec-

toralis minor and subclavius muscles ; to gain its point of insertion, it passes in front of the coraco brachialis and biceps, and behind the inner edge of the deltoid. It forms also the anterior boundary to the axilla.

Use.—To bring the arms forward and across the chest, as in the act of embracing. When the upper extremities are raised above the head and fixed, then this muscle acts powerfully in inspiration; this position is frequently taken advantage of by patients suffering from dyspnœa.

The pectoralis major also assists powerfully in raising the body from the ground when holding by a rope or a beam over the head, and in balancing the body when walking on the hands. This muscle is frequently the subject of varities in the origin and insertion here laid down, the clavicular attachment has in some cases been wanting; the number of the ribs, and the extent of sternum from which it arises, also differ in different subjects; and at the insertion it is not unfrequent to find a portion of the pectoralis major passing to be connected with the brachialis internus.

The *m. latissimus dorsi—arises* by a broad tendinous expansion (which forms in fact the posterior layer of the fascia lumborum) from the spinous processes of the sacrum, lumbar and seven or eight inferior dorsal vertebræ, from the posterior fourth of the ilium where it is connected with the origin of the glutæus maximus, from the three or four inferior ribs, near their extremities, by distinct fasciculi which digitate with the obliquus abdominis externus. The iliac and lumbar fibres pass obliquely upwards and outwards; the dorsal pass transversely, and the costal are directed nearly vertically upwards; all converging to the inferior angle of the scapula, over which they pass (frequently gaining a fresh fasciculus from that bone) towards the os humeri, into which this muscle is *inserted* by a flat tendon, along the internal edge of the bicipital groove with the teres major. The tendon by which the latyssimus dorsi terminates its insertion, is about three inches long, and turns one half upon itself, so that its lower edge receives the

dorsal fibres, and its upper edge the lumbar and costal fibres of the muscle. This tendon is connected with the tendon of the teres major; and a small bursa is usually found between them.

The upper half of the posterior surface of this muscle is covered by the trapezius, the lower half is immediately sub-cutaneous; the anterior surface is in contact with the serratus posticus inferior, sacro-lumbalis, longissimus dorsi, spinalis dorsi, obliquus abdominis externus, ribs, and inferior angle of the scapula. The tendon of this muscle passes under and behind the coraco brachialis muscle, between it and the bone, to be *inserted* in common with the tendon of the teres major, which reaches, however, rather below it, and is on a plane posterior to it.

Use.—To direct the arm backwards, and slightly rotate the limb inwards; as a muscle of inspiration, it has the power of elevating the ribs when the upper extremities are raised and fixed above the head; in this position they are capable of raising the whole body.

The superior extremity may now be separated from the trunk in the progress of the dissection of the remaining seven muscles of the shoulder-joint; but before they are examined, it is necessary to describe the fascia which covers the whole of the extremity immediately under the skin.

This aponeurosis of the upper extremity surrounds all the muscles, and has between it and the skin the sub-cutaneous nerves and veins. It is derived from the spine of the scapula and infra spinatus muscle posteriorly, it is thin and ill defined in passing over the deltoid muscle, below which it becomes stronger from an addition of fibres given off from the insertion of the deltoid; internally it is continued from the cellular membrane of the axilla, strengthened by fibres from the tendons of the pectoralis, latissimus dorsi and teres major muscles. As it descends it adheres to the lateral ridges of the humerus, forming intermuscular tendons, which on the inner side reach from the insertion of the coraco brachialis to the internal condyle; and on the outer, from the insertion of the deltoid to the outer condyle. By this

arrangement of attachment, the muscles of the fore part of the arm are separated from those of the back part; the two sets of muscles being thus inclosed in two separate bags of fascia. It is necessary to remark this arrangement, from the circumstance, that an accumulation of matter formed in one bag does not communicate with the other. This aponeurosis becomes thicker and dense as it approaches the elbow, where it completely surrounds the muscles, and is firmly attached to the condyles of the humerus and olecranon of the ulna.

Use.—The use of this aponeurosis is to support and strengthen the muscles, covering them both collectively amd individually, and preventing their displacement during action.

The *m. deltoides*—is a thick triangular muscle covering the upper part of the shoulder: it *arises* tendinous from the outer third of the clavicle, from the acromion and whole length of the inferior edge of the spinous process of the scapula. The clavicular fibres are directed downwards and backwards, the acromial fibres vertically downwards, and those arising from the spinous process pass obliquely downwards and forwards; the fibres thus converging unite in a tendon to be *inserted* into the rough surface situated immediately above the centre of the outer part of the os humeri. This muscle is composed of numerous large fasciculi, separated from each other by strong tendinous fibres; its outer surface is merely covered by skin, and a few fibres of the platysma myoides; it covers the supra, and a considerable portion of the infra spinatus muscles, and the insertion of the teres minor: in passing over the coracoid process of the scapula, it covers the insertion of the pectoralis minor, and the origins of the coraco brachialis muscle and short head of the biceps: its vertical or acromial fibres cover the insertion of the subscapularis, and the origin of the long head of the biceps, below which it passes over the tendinous insertion of the pectoralis major; and, at its point of insertion, its tendon is placed between the two origins of the brachialis internus: from the posterior edge of the deltoid, a strong fascia is given off, which covers the infra spinatus

muscle, and which afterwards unites with the aponeurosis of the arm: the anterior edge of the deltoid is separated from the pectoralis major by the cephalic vein and humeral thoracic artery. The origin of this muscle corresponds with the insertion of the trapezius. In passing over the acromion scapulæ, the tendinous fibres are very numerous, and a bursa mucosa is found, which is placed between the muscle and capsular ligament of the shoulder-joint.

Use.—The anterior fibres of the deltoid draw the arm forwards, and assist in rotating the head of the humerus inwards; the posterior direct the arm backwards, and assist in rotating the head of the humerus outwards; while the middle fibres, whether acting singly or in conjunction with the others, raise the arm, drawing it upwards and outwards. When the arm is fixed, as in the attempt to raise a very heavy weight, it draws the scapula downwards.

The *m. supra spinatus—arises* from the fossa supra spinata, from the costa of the scapula situated above the spine, also from the tendon which covers this muscle: the fibres pass from these origins outwards and forwards through the acromial notch, beneath the triangular ligament, terminating in a tendon which passes over the neck of the scapula. It is intimately connected with the capsular ligament, and is *inserted* into the anterior depression on the upper part of the greater tubercle of the os humeri.

This muscle is covered posteriorly by a strong aponeurosis, and by the trapezius; superiorly by the deltoid and coraco acromial ligament: just as it passes through the acromial notch, it has the origin of the omo hyoideus muscle above it, and there is a bursa between its tendon and the neck of the scapula.

Use.—To assist the deltoid in raising and abducting the arm; it gives strength to the capsular ligament, and uniting with the upper part of the glenoid fibro-cartilaginous tissue, it assists in supporting that cartilage in the various motions of the head of the humerus.

The *m. infra spinatus—arises* from the fossa infra spinata, from the costa of the scapula below the spine, and from the fascia which passes off from the trapezius and deltoid

muscles: from these origins the fibres converge towards the inferior part of the neck of the scapula, pass through the acromial notch, where it becomes tendinous, adhering to the capsular ligament which it strengthens; it is then *inserted* into the middle depression, on the upper part of the greater tubercle of the os humeri.

The upper posterior surface of this muscle is covered by the trapezius and deltoid, below by the latissimus dorsi, and in the intermediate space by fascia and common integument; the anterior surface is in contact with the dorsum of the scapula, and the capsular ligament; at the neck of the bone, it is furnished with a bursa. Its anterior edge is connected below with the origin of the teres major, and above with the teres minor through the medium of tendon; its posterior edge corresponds with the insertion of the rhomboideus major.

Use.—To assist in supporting the arm when raised by the action of the other muscles, to rotate the arm outwards, and to give strength to the capsular ligament.

The *m. teres minor—arises* from a slightly depressed surface between the two ridges of the anterior costa of the scapula, from its aponeurotic covering, and from the intermuscular ligament; its fleshy fibres pass upwards and outwards, adhere firmly to the capsular ligament, and are *inserted* tendinous below the m. infra spinatus, into the inferior and outer depression, on the greater tubercle of the os humeri.

The origin of the teres minor is placed between the teres major which is below it, and the long head of the triceps which is above it; the infra spinatus being behind, and the subscapularis in front. The body of the muscle runs along the under edge of the infra spinatus, and is only covered by fascia and common integuments; its insertion lies under the deltoid, so as to be concealed by it. This muscle passes to its point of insertion behind the long head of the triceps, which separates it from the teres major; it also serves to strengthen the capsular ligament.

Use.—It cooperates with the infra spinatus in drawing the humerus downwards and backwards, and rotating the head of the bone outwards.

The *m. subscapularis*—*arises* from the whole of the fossa subscapularis and the costæ of the scapula; its fibres, separated into strong fasciculi by intermuscular tendons, form a triangular fleshy belly, converging towards the coracoid notch, through which it passes. It is *inserted* by a strong tendon intimately connected with the capsular ligament, passing through it to be inserted within the capsular ligament into the lesser tubercle of the os humeri.

The anterior surface of this muscle is covered by the serratus magnus; posteriorly, it is in contact with the whole of the interior surface or venter of the scapula; below, it is in contact with the origin of the teres major; its outer edge forms the upper and posterior boundary of the axilla, and is crossed by the axillary artery, and plexus of nerves; it is covered in front of its insertion by the coraco brachialis, deltoid and short head of the biceps muscles.

Use.—The subscapularis adducts the humerus, draws it downwards, and rotates the head of the bone inwards; and, with the three last-described muscles, strengthens the capsular ligament.

The *m. teres major*—*arises* from a triangular rough surface, situated upon the posterior face of the inferior angle of the scapula, and that portion of the bone left uncovered by the infra spinatus and teres minor; the muscle assumes a round lengthened form: its fibres ascend upwards and inwards, towards the arm, to be *inserted* by a broad thin tendon, united with that of the latissimus dorsi, into the inner and posterior edge of the bicipital groove of the os humeri.

The origin of this muscle is below but slightly connected with the infra spinatus; it is covered by the latissimus dorsi, where that muscle crosses the inferior angle of the scapula; above its origin is situated the teres minor; the belly of the muscle is placed in front of the long head of the triceps, separated by it from the teres minor, which is

behind. Its tendon passes behind the coraco brachialis and short head of the biceps, in common with the tendon of the latissimus dorsi. These tendons are firmly united, excepting near the humerus, where a small bursa separates them. The relative position of these tendons with each other is, that the tendon of the latissimus dorsi is placed superior and anterior to that of the teres major; which latter, being broader, passes lower down along the edge of the bicipital groove. These united tendons form a part of the posterior boundary to the axilla, and have lying upon them the axillary vessels and nerves.

Use.—To rotate the arm inwards, and to direct it downwards and backwards; but should the humerus be fixed, it will then draw the scapula in the opposite directions.

The *m. coraco brachialis*—*arises* from the middle of the apex of the coracoid process of the scapula, and also from the inner edge of the tendon of the short head of the biceps; it forms a fleshy belly, which descends, becomes tendinous in the middle of the arm, and is *inserted* into a rough ridge at the middle and internal part of the humerus.

The origin of this muscle is situated between the short head of the biceps to its outer side, and the insertion of the pectoralis minor on its inner; the belly of the muscle then passing downwards and outwards, on the inner side of the biceps and behind the pectoralis major and deltoid, is perforated by the musculo cutaneous nerve. The insertion of the muscle takes place between the third head of the triceps and inner origin of the brachialis internus; and from which passes the intermuscular tendon to the internal condyle.

Use.—To raise and draw the arm forwards towards the body; and to rotate it outwards.

The nine muscles last described, conclude those which perform the motions of the shoulder-joint. The next set in the order of my arrangement, are those which belong to the elbow-joint; they are four in number, two flexors, and two extensors.

The *m. biceps cubiti—arises* by two heads from the scapula; the longer one by a thin tendon from the summit of the articular cavity, being continuous with the glenoid ligament; from thence, becoming contracted as it descends, the tendon passes through the capsular ligament of the shoulder-joint, is continued along the bicipital groove, after which it forms a thick fleshy belly. The shorter head arises tendinous from the outer side of the coracoid process of the scapula, in common with the coraco brachialis muscle; it almost immediately becomes fleshy, passing down to the middle of the arm, where it is intimately connected with the long head, forming one muscle which, just above the elbow, terminates in a strong flat tendon, which passes below the elbow to be *inserted* into the tubercle of the radius, having a large bursa between them. Below the elbow, previous to its insertion, it sends off an aponeurotic expansion which covers the fore arm anteriorly, and principally forms the common fascia.

The long head of the biceps is covered by the deltoid and capsular ligament of the shoulder-joint, which must be opened before it can be exposed, and in which it is covered by a reflection of the synovial membrane; while within the groove it lies between the pectoralis major and latissimus dorsi. The short head is also concealed by the deltoid and pectoralis major; the belly of the muscle is covered by the fascia and skin of the arm, and covers the coraco brachialis and brachialis internus muscles. The tendon continues superficially situated as it passes over the elbow; and it descends between the supinator radii longus on the outer side, and the pronator radii teres on the inner, to reach its point of insertion.

Use.—Principally to supine the hand; and although usually described as a flexor to the elbow-joint, it cannot assist in this motion until the brachialis internus has first brought the fore arm to an angle with the humerus; therefore this muscle might rather be considered as belonging to the radio-ulna articulation. Its long head tends to strengthen and support the shoulder-joint.

The *m. brachialis internus—arises* by a tendinous and

fleshy origin on each side of the insertion of the deltoid muscle; it also arises fleshy from the remaining part of the anterior surface of the humerus: from these origins the muscle becomes broader, descends in front of the elbow-joint, adhering to the anterior ligament, and forms a strong tendon, which is *inserted* into a rough depression immediately below the coronoid process of the ulna.

The inner origin of this muscle lies between the insertions of the deltoid and coraco brachialis; the outer origin between the insertion of the deltoid and origin of the third head of the triceps: the belly of the muscle is covered by the biceps: the tendon passes down through the triangular space formed by the supinator radii longus, and pronator radii teres, and is here covered by the tendon of the biceps.

Use.—To flex the fore arm and to strengthen the elbow-joint.

The *m. triceps extensor cubiti—arises* by three distinct heads: the first, or long head, by a broad tendon from the anterior costa of the scapula, immediately below the glenoid cavity, and is intimately connected with the glenoid ligament; this head separates the teretes from each other: the second head arises on the outer and back part of the greater tubercle of the os humeri, commencing immediately below the point where the teres minor is inserted: the third head arises from the inner edge of the bicipital groove, commencing immediately below the insertion of the teres major. By the union of these origins, a thick fleshy muscle is formed in the middle of the posterior part of the humerus, being attached to the lateral ridges of the bone as far as the condyles; it then forms a strong thick tendon, which firmly unites to the posterior ligament of the elbow-joint, and is *inserted* principally into the olecranon, but descends also to be attached to the superior part of the posterior spine of the ulna.

This tendon sends off an aponeurotic expansion to assist in forming the general fascia of the fore arm. By attending to the relative position of the three heads of this muscle with respect to the teretes as described, the pupil readily

comprehends their origins; the posterior surface of this muscle is covered by the fascia and common integuments, the anterior surface is in contact with the humerus, spiral nerve and superior profunda artery; and close to its insertion with the posterior ligament of the elbow-joint.

Use.—To extend the fore arm, and to carry it backwards and inwards when the long head is principally in action.

The *m. anconeus*—is usually described when speaking of the muscles arising from the external condyle; but according to my arrangement is now to be described as one of the extensors of the elbow-joint. It *arises* from the outer and inferior part of the external condyle of the humerus connected with the tendon of the triceps, it forms a triangular fleshy muscle, adheres to the posterior and external lateral ligaments of the elbow-joint; and passing over the superior radio ulnar articulation, where it has a bursa underneath it, is *inserted* into a flat roughened surface, below and to the outer side of the olecranon, and into the posterior spine of the ulna.

This muscle is covered posteriorly by the integuments and tendon of the triceps; anteriorly, it is in contact with the supinator radii brevis, and covers the annular ligament of the radius; it is situated between the olecranon and origin of the extensor carpi ulnaris.

Use.—To assist the triceps in extending the fore arm.

In the progress of dissection, we will now describe the fascia of the fore arm. It arises around the elbow-joint, proceeding anteriorly from the aponeurotic expansion of the tendon of the biceps; posteriorly, from the tendinous insertion of the triceps; and laterally, from the condyles and intermuscular tendons, which have already been described: from these sources it descends over the fore arm, forming a strong aponeurotic investment, which confines the muscles in their proper situation, and maintains the general contour of the arm. At the wrist it assists anteriorly in forming the ligamentum carpi annulare, which is rendered infi-

nitely stronger by cross fibres proceeding from the bones of the carpus; posteriorly it forms the ligamentum carpi annulare dorsale, which is not so strong as the anterior carpal ligament, but is connected to the edges of the sulci, on the back part of the inferior extremity of the radius, forming them into fibrous canals for each of the extensor tendons. The superficial radial ulna and median veins pass up from the wrist to the elbow on the anterior and exterior surface of this fascia, together with branches of the cutaneous nerves; the interior surface of this fascia sends off processes, which dip between, and envelop the muscles of the fore arm.

From the function of the muscles of the fore arm, I have divided them into those of the radio ulnar articulations, those of the wrist-joint, and those common and proper to the fingers; but from their complicated connection with each other, considerable confusion would arise from their dissection in that order. It is therefore necessary, first, to classify them as the muscles placed between the radius and ulna, anteriorly, and posteriorly, and to subdivide each of them into two layers.

The muscles situated between the radius and ulna in front, are eight in number, principally arising from the internal condyle, and are divided into a superficial layer, consisting of five, and a deep-seated layer consisting of three muscles; of the five superficial, beginning from the outermost of them, we first expose the pronator radii teres of the radio ulnar articulation; next succeed the flexor carpi radialis and palmaris longus, two flexors of the wrist-joint; then the flexor sublimis perforatus, a muscle common to the fingers; and, lastly, the flexor carpi ulnaris, the third flexor of the wrist.

The *m. pronator radii teres*—*arises* tendinous and fleshy from the anterior and outer part of the internal condyle of the humerus, from the coronoid process of the ulna, and from the intermuscular fascia of the fore arm; from these origins the muscle proceeds downwards and obliquely outwards to be

inserted tendinous into the asperity on the middle and outer part of the radius, immediately below the supinator radii brevis.

This muscle at its origin has the flexor carpi radialis on its inner side, with which it is blended, and the tendon of the biceps and brachialis internus on its outer side, as they are passing to their insertions, also the brachial artery and median nerve: the anterior surface is covered above by the skin and aponeurosis of the fore arm, at its insertion by the supinator radii longus, the radial extensors of the wrist, and the radial artery and nerve; it lies upon the brachialis internus and flexor sublimis muscles, median nerve and ulna artery.

Use.—To roll the radius upon the ulna, and thus to render the hand prone.

The *m. flexor carpi radialis*—*arises* narrow and tendinous from the fore part of the internal condyle of the humerus, also from the outer and back part of the coronoid process of the ulna, and from intermuscular tendon; it then proceeds fleshy downwards and obliquely outwards; and at the lower third of the fore arm it forms a strong tendon, which passes under the annular ligament, through a groove in the os trapezium, to be *inserted* into the base of the fore part of the metacarpal bone of the index finger.

At its origin this muscle is placed between the pronator radii teres on its outer side, and palmaris longus on its inner, between which muscles it passes downwards towards its insertion; and having gained the point of insertion of the pronator radii teres, it has to its radial side the supinator radii longus, and the radial artery and nerve; it is superficial in its whole course, until it passes into the hand, and there becomes covered by the annular ligament and muscles proper to the thumb; it lies upon the flexor sublimis, flexor longus pollici and wrist-joint.

Use.—With all the muscles inserted either into the bones of the carpus or metacarpus, to move the wrist-joint, which it flexes and slightly pronates.

The *m. palmaris longus—arises* from the fore part of the internal condyle of the humerus, laterally from the inter-muscular tendons, and in front from the fascia of the fore arm; it then forms a very short fleshy belly, which soon becomes tendinous, and passes downwards in the middle of the fore arm to be *inserted* into the annular ligament, or rather it may be said, to be attached partly to this ligament and partly passing over it, into the palm of the hand, forms the palmar facia, which terminates by four fasciculi at the digital extremities of the four metacarpal bones.

This muscle is sometimes wanting either on both or only one side; it is covered anteriorly by the common integuments and aponeurosis of the fore arm; it covers the flexor sublimis above; but below, while passing to the annular ligament, it gets to the outer side of the tendons of the flexor sublimis, and has the median nerve immediately behind it.

Use.—To fix the wrist-joint, to render tense the palmar fascia, and to protect the vessels and nerves situated in the palm of the hand.

The *m. flexor digitorum sublimis vel perforatus.*—Before this muscle can be dissected perfectly from its origins, the three last described muscles should be divided, and reflected towards their attachments, when the flexor sublimis muscle will be found to have four distinct origins from the bones of the upper extremity; first, from the internal condyle of the humerus, connected to the bone by tendon common to it and other muscles; secondly, from the root of the coronoid process of the ulna, immediately below the insertions of the brachialis internus muscle; thirdly, from the radius, just below the tubercle of that bone, and consequently close to the insertion of the biceps; fourthly and lastly, from the fore part of the radius, and middle third of its outer edge: from these different origins, the fibres unite to form one fleshy muscle, which soon sends off four tendons; two anterior of which are for the middle and ring fingers, and the two posterior for the index and little fingers: they pass underneath the annular ligament, between the fascia palmaris and tendons of the deep flexors of the fingers, till

they arrive at the base of the first phalanx, where each of them becomes enclosed in a sheath or theca with a deep flexor tendon; thus they proceed to the second phalanx, where the flexor sublimis splits into two for the tendon of the flexor profundus to pass through it to be inserted into the extreme phalanx, while the tendon of the flexor sublimis is *inserted* into the anterior part of the second phalanx.

The origins of this muscle are covered by the pronator radii teres, flexor carpi radialis and palmaris longus; the belly of the muscle continues down the arm under the aponeurosis, behind the annular ligament and palmar fascia, to reach its four insertions, as already described. The muscle, in its course down the arm, lies upon the flexor profundus perforans, the flexor longus pollicis, the median nerve, the lumbricales muscles, and lastly, the phalanges of the fingers.

Use.—To bend the second phalanges of the fingers upon the first, and contribute to the contractions of the fingers as in grasping.

The *m. flexor carpi ulnaris.*—This is the last of the five muscles superficially situated between the radius and ulna in front; it *arises* from the inner side of the internal condyle of the humerus, and from the olecranon process of the ulna by a separate and distinct fasciculus, the ulna nerve and recurrent artery being situated between the two origins; it also arises aponeurotic from the posterior ridge of the ulna, running down as far as the pronator quadratus muscle, and from the fascia of the fore arm; from these tendinous origins, the fibres pass obliquely downwards and outwards, forming a semipenniform muscle, to be attached to a tendon which is *inserted* into the pisiform bone of the carpus; dividing here into two sets of fibres—the one of which crosses the ulna artery to be attached to the annular ligament, so as to form a foramen for the vessel; while the others pass downward to be connected with the palmar fascia.

This muscle is covered anteriorly by the fascia of the fore

arm; it covers posteriorly the flexor digitorum perforans, the ulna artery and nerve, and the pronator quadratus muscle; its outer edge, at its origin, is united to the flexor perforatus; but as they descend they separate; and between them, or on the radial side of the flexor carpi ulnaris, is situated the ulna artery and nerve.

Use.—To flex the wrist-joint, and to direct the hand slightly inwards.

These five superficial muscles should now be cut through and reflected, to expose the three deeper seated; which comprise the flexor digitorum profundus vel perforans, common to the fingers; the flexor longus pollicis, proper to the thumb; and the pronator quadratus, a muscle of the radio-ulnar articulations.

The *m. flexor digitorum profundus vel perforans.*—This muscle *arises,* tendinous and fleshy, from the inner side of the upper extremity of the ulna, between the coronoid process and olecranon, from the root of the coronoid process surrounding the insertion of the brachialis internus muscle, from three superior fourths of the anterior surface of the ulna, reaching as far down as the attachment of the pronator quadratus, from the radial side of the ulna, and inner half of the interosseous ligament: it forms a strong fleshy muscle, terminating in four tendons, which pass under the annular ligament, where they are confined by surrounding cellular membrane. From this point they separate in the palm of the hand, and pass to the ligamentous sheaths of the fingers, perforating the tendons of the superficial flexors, to reach their *insertions* into the last phalanx of each finger.

This muscle is covered anteriorly by the flexor sublimis and flexor carpi ulnaris, the ulnar and median nerve, and the ulnar artery; it lies upon the fore and inner surfaces of the ulna, the interosseous ligament and vessels, the pronator quadratus, and the carpus and metacarpus.

The tendons of the flexor profundus and sublimis digitorum are confined in a peculiar tendinous sheath, given off from the anterior surface of the phalanges, and forming

with them a complete canal, partly bony and partly fibrous. This canal is lubricated with synovia, and affords free motion to these tendons. It is composed of extremely short, dense, interlacing fibro cartilage, of a pearly hue, and firmly attached to the ridges of the interior surface of the phalanges. It commences by fibres given off from the inferior metacarpal ligament, are strongest and thickest opposite the middle of the first and second phalanges, and thinnest over the articulations, and terminate by an interlacement with the tendons of the flexor profundus, at their insertions in the third phalanges.

Use.—To bend the last, or ungual phalanx, on the second; if its contraction be still maintained, it will tend to bend the second on the first, and at last even produce flexion of the wrist joint.

The *m. flexor tertii internodii;* or, *longus pollicis manus.*—This muscle *arises* fleshy from the whole of the fore part of the radius situated between the insertion of the biceps into the tubercle above, and the attachment of the pronator quadratus within two inches of the lower extremity of the bone below, and from the outer side of the interosseous ligament; it has also a tendinons origin from the internal condyle, which, passing from the radial origin to the condyle, separates the superficial from the deep layer of muscles. The belly of this muscle has its fibres passing obliquely downwards to terminate in a tendon on its anterior surface, which tendon proceeds downwards, passes behind the annular ligament, then between the two origins of the flexor brevis pollicis and the two sesamoid bones, it reaches its *insertion* on the anterior part of the base of the extreme phalanx of the thumb.

This muscle lies to the outer side of the flexor profundus, covered by the flexor sublimis; its slip from the internal condyle, as has been already mentioned, separating them. Its tendon at the lower part of the arm covers the pronator quadratus, then passes under the annular ligament, and is concealed by the muscles of the thumb, and cannot be traced

until the hand is dissected. The belly of the muscle lies upon the radius and interosseous ligament.

Use.—To flex the extreme phalanx of the thumb upon the second.

The *m. pronatus quadratus*—*arises,* on the inner side of the ulna, from a space about two inches in length, situated between the styloid process and lower attachment of the flexor carpi ulnaris; from thence it proceeds transversely, adhering to the interosseous ligament, and is *inserted* into the lower and outer part of the radius, between the styloid process and attachment of the flexor longus pollicis.

Anteriorly all the tendons which pass to the hand cross this muscle; it lies upon the bones and interosseus ligament.

Use.—To roll the radius inwards upon the ulna, and thus to prone the hand.

The muscles situated between the radius and ulna, posteriorly, are eleven in number, which we may divide into a superficial layer, composed of eleven, and into a deep-seated layer, composed of five muscles. Collectively these muscles are extensors to the wrist and fingers, and supinators of the radio ulnar articulations. The superficial layers, six in number, all arise from the inferior extremity of the humerus.

The *m. supinator radii longus.*—This muscle *arises* from the external ridge of the os humeri, beginning immediately below the insertion of the deltoid, and continuing its origin to about two inches of the external condyle, from whence the extensor carpi radialis longior begins to arise, also from the outer intermuscular tendon; it then forms itself into a thick muscle, which becomes narrower as it descends below the elbow-joint, and about the middle of the outer side of the fore arm it terminates in a tendon, at first flat, afterwards rounded, which proceeds along the outer side of the radius to the styloid process, into the anterior part of which it is *inserted.* At the base of the styloid process, the tendon sends off an aponeurotic expansion, which passes upon the posterior surface of the radius, so as to assist in forming the sulcus for the passage of the extensor primi and secundi internodii into

a foramen. This muscle is only covered by the integuments and aponeurosis. Its origin is bounded in front by the brachialis internus; behind, by the triceps; above, by the deltoid; and below, by the extensor carpi radialis longior: as it passes over the joint, it lies upon the extensores carpi radialis longior and brevior; it then descends along the radius, between the flexor carpi radialis, which is anterior to it, and the extensor carpi radialis longior, which is posterior; and at its insertion the tendon is crossed by the extensors of the thumb. In the lower third of the arm, its tendon forms a guide to the radial artery, which is placed just on its ulna side, between it and the flexor carpi radialis.

Use.—To roll the radius outwards from the ulna, and to turn the hand supine; it also assists the flexors of the elbow-joint in bending the fore arm on the humerus; but is nevertheless classified as a muscle of the radio-ulnar articulations.

The *m. extensor carpi radialis longior*—*arises* from the lower part of the external ridge of the os humeri, between the origins of the supinator radii longus and the extensor carpi radialis brevior; it forms a short thick fleshy belly, which passes over the outer side of the elbow-joint, proceeds downwards upon the back part of the radius, at the middle of which it becomes tendinous. The tendon continues downwards to the inferior and back part of the radius, where it passes through a sulcus, crosses the carpus to be *inserted* into a small tubercle in the posterior face of the metacarpal bone of the fore finger.

The humeral attachment of this muscle is placed between the brachialis internus in front, the triceps behind, the supinator radii longus above, and the extensor carpi radialis brevior below; on the outer side of the elbow it lies upon the extensor carpi radialis brevior and the supinator radii brevis, being covered by the supinator radii longus; it passes down the fore arm, still covered by this muscle, until it reaches the inferior extremity of the radius, where it passes underneath the extensor tendons of the thumb and dorsal annular ligament to gain its insertion.

Use.—To extend the wrist-joint by drawing the hand backwards, and assist in bending the fore arm; it is one of three extensors of the wrist-joint.

The *m. extensor carpi radialis brevior*—*arises* from the back part of the external condyle of the humerus and external lateral ligament, immediately below the origin of the extensor carpi radialis longior: it then forms a thick belly which passes over the superior radio ulnar articulation, continues down along the back part of the radius, and terminates in a round tendon, which proceeds through the same groove with the last described muscle, under the annular ligament, to be *inserted* into the posterior part of the base of the metacarpal bone of the middle finger.

This muscle at its origin lies between the extensor carpi radialis longior, which is above and anterior to it, and the extensor longus digitorum, which is behind it; then proceeds along the fore arm, partly covered by the extensor carpi radialis longior; its tendon runs through the same groove with it, under the extensors of the thumb; after which it separates from the tendon of the longior and passes under the indicator to its insertion.

Use.—The same as the last muscle; and is the second extensor proper to the wrist.

The *m. extensor digitorum communis*—*arises* from the external condyle by a tendon common to it, the extensor carpi radialis brevior and the extensor carpi ulnaris; a portion of this tendon runs down in the course of the inner side of the muscle, which it divides into fasciculi, the inner of which is by some anatomists termed the extensor proprius minimi digiti; a similar process of tendon runs down on the outer side of the muscle, and separates it from the extensor carpi radialis brevior. This muscle also arises posteriorly from the inner surface of the fascia of the fore arm; it then forms a fleshy belly of unequal thickness, but thickest in the centre; it passes downwards obliquely towards the inner part of the fore arm, and at the middle of its posterior surface divides into four distinct tendons which

are connected with each other by cellular membrane, and together pass behind the ligamentum carpi dorsale through a groove common to them and the tendon of the extensor indicis. These tendons separate upon the dorsum of the carpus, and continue diverging to the articulation between the metacarpus and first phalanx, thence proceeding to be finally *inserted* into the extreme phalanx of each finger. While these tendons are situated on the matacarpus they are thin and broad, and connected with each other by small tendinous bands; while on the dorsal region of the first phalanges the tendons are thicker and more contracted, receiving the tendinous insertions of the lumbricales and interossci, and forming with them a continuation of aponeurosis, which covers the whole length of the back of the fingers.

The origin of the extensor digitorum communis is placed between the extensor carpi radialis brevior and extensor carpi ulnaris; as it proceeds down on the posterior surface of the arm it covers the supinator radii brevis, the extensores pollicis et indicis, posterior surface of the carpus, metacarpus, interossei dorsales, and the fingers. An interval is left on the outer side of the back of the arm, between this muscle and the extensor carpi radialis brevior, in which may be seen the extensores primi et secundi internodii pollicis.

Use.—To extend all the fingers; and, in its fullest contraction, to extend the hand upon the fore arm.

The *m. extensor carpi ulnaris*—*arises* fleshy and tendinous from the upper and back part of the outer condyle, between the extensor digitorum communis and anconeus; fleshy from the intermuscular tendon and fascia of the fore arm, and also from a considerable portion of the back part of the ulna: its fleshy belly terminates in a tendon which continues down on the back part of the ulna, then passes through a groove immediately on the outer side of the styloid process of that bone; from thence, under the annular liga-

ments, to be *inserted* into the back part of the metacarpal bone of the little finger.

This muscle is superficially situated; from its origin it passes down between the extensor digitorum communis and flexor çarpi ulnaris, being separated however from the latter muscle by the internal ridge of the ulna.

Use.—To extend the wrist-joint, it is the third extensor to this articulation; but if singly in action it bends the hand laterally towards the ulna.

The *m. anconeus*—forms the sixth muscle superficially situated in this region; it has already been described together with those whose function is to give motion to the elbow-joint.

The progress of the dissection is best conducted by cutting through these six superficial muscles, and reflecting them towards their origins and insertions, in order to expose the five deep-seated muscles of this region, allowing them still to remain attached, as it gives to the student an opportunity to refer to their relative position.

Of the five deep-seated muscles, one is belonging to the radio ulnar articulations, three are proper to the thumb, and one proper to the index finger.

The *m. supinator radii brevis*—*arises* tendinous and fleshy from the back part of the external condyle of the humerus, and from a ridge on the outer side of the ulna, extending downwards from its lesser sigmoid cavity; from these origins the belly of the muscle winds around the superior radio ulnar articulation, being firmly attached, and indeed partly arising from its ligaments; it then passes to the anterior and inner surface of the radius, to be *inserted* into the upper third of this bone, in a space between the insertions of the biceps above, and the pronator radii teres below.

This muscle surrounds the superior radio ulnar articulation: it is covered on its outer side by the supinator radii longus, and the extensores carpi radiales; behind, by the

extensor digitorum, extensor carpi ulnaris, and anconeus; in front by the brachialis internus and tendon of the biceps.

Use.—To roll the radius outwards, and supine the hand.

The *m. extensor primi internodii pollicis.*—This muscle is by most anatomists termed the extensor ossis metacarpi pollicis, but having already, when treating on osteology, given the reasons why the thumb should be considered as wanting a metacarpal bone and possessing three phalanges, it will be consistent with my views to describe this muscle as the extensor to the first phalanx of the thumb. It *arises* tendinous from a small spine situated on the back part of the ulna, immediately below the origin of the supinator radii brevis; fleshy from the interosseous ligament, and also fleshy from the radius, immediately below the insertion of the supinator radii brevis; from these origins the muscle forms a considerable belly which passes obliquely downwards and outwards to the inferior extremity of the radius, within about an inch of which it forms a tendon; that tendon proceeds through the outer groove on the back part of the radius, with the tendon of the extensor secundi internodii, being tied down by the posterior annular ligament, and lubricated by a bursa mucosa; on emanating from this groove, the tendon splits into two or three portions to be *inserted* into the outer part of the base of the first phalanx of the thumb, into the os trapezium, and is also usually connected with the abductor pollicis. The anterior surface of this muscle is in contact with the ulna, interosseous ligament, and radius, and below this with the tendons of the extensor radialis longior, and brevior; posteriorly, it is covered by the extensor longus digitorum, extensor carpi ulnaris, and extensor tertii internodii with which it is united.

Use.—To carry the thumb backwards, and also abduct it, from which circumstance, it is by many anatomists termed the abductor longus pollicis. It contributes in some measure to supine the hand.

The *m. extensor secundi internodii pollicis*—*arises* fleshy

from the back part of the ulna, below its middle, and beneath the origin of the last described muscle; from the interosseous ligament, and from a considerable portion of the posterior surface of the lower third of the radius: it then forms a shorter and thinner belly than the preceding muscle; but taking the same direction, forms a slender tendon at the outer side of the lower extremity of the radius, passes through the same groove, but continuing further is *inserted* into the posterior part of the second phalanx of the thumb, sometimes reaching to the base of the third.

Its relative situation is much the same as that of the extensor primi internodii; but it covers in part the second as well as the first phalanx of the thumb.

Use.—To extend the second on the first phalanx, and to assist in the abduction of the thumb, and in the supination of the hand.

The *m. tertii internodii pollicis*—*arises* from the posterior surface of the ulna about the point of junction of its superior with its middle third, and also from a small portion of the interosseous ligament. It is then directed downwards and outwards, partly covers the origins of the extensor primi and secundii internodii, and forming a slender tendon at the lower part of the radius, passes through a groove of its own, which is placed between that for the extensors of the wrist, and the one for the common extensor tendons of the fingers, and the tendon of the extensor indicis. The tendon of the extensor tertii internodii then passes on the inner and posterior part of the first phalanx, reaches the second, where it is connected with the tendon of the secundi internodii muscle, and is *inserted* into the root of the third or extreme phalanx of the thumb.

This muscle lies upon the extensor primi and secundi internodii, upon the radius and ulna, upon the two radial extensors of the wrist, and upon the three phalanges of the thumb. It is covered by the extensor digitorum, extensor carpi ulnaris, and extensor indicis muscles.

Use.—It extends the third phalanx of the thumb upon the second, and in other respects assists in the action of the two muscles preceding it.

The *m. extensor indicis—arises* by fleshy and aponeurotic fibres from the posterior surface of the ulna, just on the inner side of the tertii internodii muscle, also from the interosseous ligament; it increases in size as it descends towards the hand, and immediately above the lower extremity of the radius it forms a slender tendon, which passes through the same groove with the tendons of the extensor digitorum, being united by one synovial membrane; arriving on the back of the hand, it passes to the index finger on the outer side of the slip of tendon from the extensor digitorum communis, and is *inserted* with it into the second and third phalanges. This muscle is covered by the extensor carpi ulnaris, and extensor digitorum communis, and it lies upon the ulna, interosseous ligament, the extensor tertii internodii, and radius and carpus.

Use.—To assist the tendon of the extensor digitorum to extend the fore finger; or, to act without the assistance of that muscle, as in pointing the fore finger.

The dissection of the palm of the hand may now proceed; but it is necessary to remark, that the insertion of several of the muscles already described are not proper to the hand, but yet, lying deeply under the palmar fascia, their final insertions cannot be examined, until the parts we are now about to describe are first dissected. Upon removing the skin from the palm of the hand, we shall find it thicker than on other parts of the body, excepting the sole of the foot, in consequence of the pressure to which it is constantly exposed. Immediately under the skin is found a strong aponeurotic expansion, which is termed the fascia palmaris, and upon it lies posteriorly a small cutaneous muscle.

The *m. palmaris brevis—arises* by thin separated fasciculi from the inner side of the anterior surface of the annular ligament, proceeds outwards in a transverse direction across the upper part of the palm of the hand, to be *inserted* into the skin which covers the ball of the thumb.

The skin covers the anterior surface of this muscle; and

posteriorly it lies upon the muscles of the little finger, fascia palmaris, ulna artery and nerve.

The *fascia palmaris*—is extended from the annular ligament of the wrist, and from the tendon of the palmaris longus muscle by a narrow commencement; it proceeds downwards, its fibres diverging so as to cover the inferior surface of the palm of the hand, while it only covers the central third of the superior, leaving the bases of the metacarpal bones of the thumb and fore finger uncovered. It is attached to the inferior extremities of the four metacarpal bones, admitting the passage of the tendons to the fingers. This fascia is very dense and strong, and may be divided into four distinct fasciculi, which are connected by cross bands.

The anterior surface of this fascia is covered by the skin, palmaris brevis muscle, and superficial palmar arch of the ulnar artery; posteriorly it covers the tendons and muscles of the palm of the hand, to which it gives strength and support.

On removing the palmar fascia, we expose the muscles which are underneath it in the following order ; those proper to the thumb, on the outer side ; those proper to the little finger, on the inner side ; and in the middle, the tendons of the long flexors common to the fingers, with the lumbricales attached to them.

The origin and insertion of the long flexors have already been described ; but we have now, to complete the muscles connected with the function of flexion of the fingers, to dissect the third or short flexor.

The *m. lumbricales*—are four small muscles, which *arise* from the outer side of the tendons of the flexor profundus perforans muscle, immediately they have passed from under the ligamentum carpi annulare ; and as those tendons, so do the lumbricales muscles diverge, and direct themselves towards the fingers, forming four distinct fasciculi. Beginning from the outer side, the first is attached to the radial side of the deep flexor of the index finger ; the second to the

ulnar side of the same tendon, and radial side of the flexor tendon of the middle finger; and the others in the same manner, so as to be attached to two tendons. From these attachments they proceed diverging to the metacarpo phalangeal articulations, and there become thin and tendinous, pass behind the first phalanx of each finger, and are *inserted* into the root of the first phalanx, and by a tendinous expansion which is common to these muscles, the extensor digitorum communis, and corresponding interossei, into the back part of all the phalanges of the fingers.

These small muscles are covered by the tendons of the flexor sublimis digitorum, deep palmar vessels and nerves, and posteriorly they lie upon the interossei.

Use.—To assist in flexing the first phalanx of the fingers, and when the tendons of the flexor perforatus are fixed, they can extend the first and middle phalanges. When they act in common with their corresponding interosseous muscle, they can adduct and abduct their respective fingers.

The muscles proper to the thumb are eight in number: three flexors, three extensors, an abductor and an adductor. Four of these have already been described, as they arise from the fore arm, viz., the flexor longus pollicis, or flexor tertii internodii, and the three extensors of the thumb; there are only left, therefore, in the palmar region two other flexors, the abductor, and the adductor muscles to be given. These muscles are covered by a thin aponeurosis.

The *m. abductor pollicis*—is somewhat of a triangular form *arising* by a broad tendinous and fleshy origin, from the anterior surface of the os scaphoides and trapezium, from a corresponding part of the ligamentum carpi annulare, and it is connected with the extensor primi internodii; from these attachments the muscle forms a thick belly, which passes outwards to be *inserted* tendinous into the radial side of the base of the second phalanx, sending off an aponeurotic expansion, which assists in covering the dorsal surface of the thumb.

This muscle is superficially situated, being only covered

by the skin and a thin aponeurosis; it lies upon the two short flexors of the thumb.

Use.—Its use is implied by its name, separating the thumb from the fingers.

The *m. flexor primi internodii,* or *apponens pollicis*—*arises* fleshy and tendinous from the os naviculare, and from the os trapezium close to the groove in that bone for lodging the tendon of the flexor carpi radialis; it also arises from the ligamentum carpi annulare, from thence it descends to be *inserted* by short tendinous fibres along the whole length of the outer edge of the first phalanx.

This muscle is usually termed the flexor ossis metacarpi, as the antagonist to the extensor ossis metacarpi; but of both these muscles I have changed the name, for reasons already given.

Nearly the whole of this muscle is covered by the abductor pollicis, and it lies upon the flexor secundi internodii, and the articulation of the trapezium with the first phalanx.

Use.—To flex the first phalanx on the trapezium, and to direct the thumb towards the fingers and palm of the hand.

The *m. flexor secundi internodii,* or *flexor brevis pollicis*—*arises* by tendinous origins from the ossa unciforme, magnum, trapezoides, and trapezium, and also from the metacarpal bones of the ring, middle and fore fingers; the belly of this muscle, almost immediately after its origin, is separated into two fasciculi by the tendon of the flexor tertii internodii; but they unite below it, and descend to the lower extremity of the first phalanx, where they again separate to be *inserted* into the two sesamoid bones, which are connected by ligament and a continuation of the tendons of this muscle, with the fore part of the scond phalanx of the thumb.

This muscle is covered by the abductor pollicis, and more on its inner side by the flexor profundus digitorum and two first lumbricales muscles; it lies upon the outer interossei muscles and tendon of the flexor carpi radialis; it has to its outer side the flexor primi internodii, and on its inner the adductor pollicis.

Use.—To flex the second on the first phalanx.

The *m. adductor pollicis—arises* by a broad origin from a slight concavity on the anterior part of the metacarpal bone of the middle finger, between two of the interossei muscles; from these origins it passes transversely outwards, anterior to the metacarpal bone of the fore finger, its fibres converging as it proceeds is *inserted* tendinous into the inner side of the root of the second phalanx and inner sesamoid bone.

This muscle is concealed by the flexor profundus and lumbricales; posteriorly it is bounded by the two first interossei, abductor indicis, and skin; its outer edge runs along the inner edge of the flexor secundi internodii, or brevis pollicis.

Use.—To draw the thumb towards the fingers.

Of the two muscles proper to the index finger the extensor has been already described, as arising from the fore arm; but the origin and insertion of the one situated within the palm of the hand, has yet to be given.

The *m. abductor indicis—arises* tendinous and fleshy from the os trapezium, from the inner side of the lower half of the first phalanx of the thumb, and from the metacarpal bone of the fore finger; its fibres extend obliquely downwards and inwards, and terminate in a thin tendon which passes over the metacarpo phalangeal articulation, to be *inserted* into the outer side of the root of the first phalanx of the fore finger.

This muscle is superficially situated posteriorly; anteriorly it is covered by the adductor pollicis: these two muscles being separated from each other by the radial artery.

Use.—To abduct the fore finger, or to assist in adducting the thumb; it may be considered as a posterior interosseous muscle to the fore finger.

The three muscles proper to the little finger are placed within the palm of the hand, and are therefore now to be described.

The *m. abductor minimi digiti—arises* principally tendinous from the os pisiforme, and fleshy from the ligamentum carpi annulare; the belly of this muscle is large and flat-

tened, is connected by intermuscular tendon with the flexor brevis minimi digiti, and passes along the metacarpal bone to reach the ulnar side of the root of the first phalanx, into which it is *inserted* by a narrow tendon, as well as into the tendinous expansion which covers the dorsal surface of the fingers.

The palmaris brevis, at its origin, partly covers this muscle.

Use.—To draw the first phalanx of the little finger from the other fingers, and assist in extending the second and third phalanges.

The *m. flexor brevis minimi digiti—arises* from the hamillary process of the unciform bone, and from the ligamentum carpi annulare; it is at first thin, then becomes broader, and terminates by a narrow tendon which is connected with that of the abductor muscle, and passes to be *inserted* into the root of the first phalanx of the little finger.

This muscle is covered by the palmaris brevis, lies on the radial side of the abductor minimi digiti, and on the ulna side of the adductor muscle, which it partly covers.

Use.—To flex the first phalanx of the little finger, and direct it towards the others.

The *m. adductor minimi digiti—arises* from the os unciforme, on the radial side and beneath the last muscle, and also from the ligamentum carpi annulare; it forms a thick fleshy muscle which passes to be *inserted* along the whole length of the radial side of the metacarpal bone of the little finger, and generally into the root of the first phalanx or sesamoid bone, when the little finger is furnished with them.

The adductor muscle is covered by the abductor and flexor brevis minimi digiti.

Use.—To draw the metacarpal bone of the little finger towards the palm of the hand; and by pressing it against the metacarpal bone of the ring finger, forms the palm into a concavity.

All these muscles which have just been described as belonging to the dissection of the palm of the hand, should now be carefully removed, and there will be exposed seven

muscles occupying the spaces between the metacarpal bones, termed the interossei; which, being inserted into the tendons of the extensor longus digitorum, I have classified collectively as one of the five muscles common to the fingers, under the name of the short extensor to the fingers.

Four of these muscles will be found situated on the palmar, and three on the dorsal region of the hand. Those on the palm are termed the *interossei interni*, and are disposed in the following manner: two pass to be inserted into the index finger, one into the ring, and the fourth into the little finger. Beginning from the outer side, the first of these muscles to be dissected, is

The *m. prior indicis—arises* from the radial side of the metacarpal bone of the fore finger, and from a small portion of the first phalanx of the thumb; these fasciculi, being separated from each other, admit the passage of the radial artery between them; they soon, however, unite and pass to be *inserted* principally into the extensor tendon of the index finger, and also into the root of the first phalanx.

Posteriorly, this muscle is only covered by the skin of the back of the hand; anteriorly it is concealed by the first lumbricalis muscle, and the muscles proper to the thumb.

Use.—To assist in extending the fore finger, also to abduct it, and to draw the first phalanx of the thumb towards the metacarpal bone of the fore finger.

The *m. posterior indicis—arises* from the ulnar side of the metacarpal bone of the fore finger, as far upwards as the ligaments connecting that bone with the trapezoid; then passing downwards, between the metacarpal bones of the index and middle fingers, passes to be *inserted* into the extensor tendon and first phalanx of the fore finger.

This muscle is covered by the flexor brevis and adductor pollicis.

Use.—To assist in extending the fore finger; and, being extended, to adduct it.

The *m. prior annularis—arises* on the radial side of the

metacarpal bone of the ring finger, along its whole length; and its tendon is *inserted* into the outer side of the first phalanx and extensor tendon of the ring finger.

It is covered by the lumbricales, and flexor profundus muscle.

Use.—To extend the ring finger, and draw it when extended towards the middle finger.

The *m. interosseus annularis*—*arises* from the root and radial side of the metacarpal bone of the little finger, and is *inserted* into the extensor tendon and outer side of the first phalanx of the same finger.

It is placed immediately underneath the flexor brevis minimi digiti.

Use.—To extend and draw the little finger towards the ring finger.

The *interossei externi*—are those muscles situated on the back of the hand, between the metacarpal bones; one on each side of the metacarpal bone of the middle finger and the third on the ulnar side of the ring finger. They each *arise* from two metacarpal bones, and are therefore sometimes called the interossei bicipetes.

The *m. prior medii digiti*—*arises* from the roots of the metacarpal bones of the index and middle fingers, and passes to be *inserted* into the extensor tendon of the middle finger and radial side of the first phalanx.

Its posterior surface is covered by the tendons of the extensor digitorum communis, and by an aponeurosis proceeding from one metacarpal bone to the other; and its anterior surface, which is much the narrower, is concealed by the adductor pollicis.

Use.—To extend and abduct the middle finger.

The *m. posterior medii digiti*—*arises* from the upper extremities of the metacarpal bones of the middle and ring fingers, and is *inserted* into the extensor tendon and ulnar side of the first phalanx of the middle finger.

It is covered posteriorly by the tendon of the extensor communis digitorum.

Use.—To extend and draw the middle finger towards the ring finger.

The *m. posterior annularis—arises* from the bases of the metacarpal bones of the ring and little fingers, and is *inserted* into the ulnar side of the ring finger.

It is covered posteriorly by the common extensor tendons, and anteriorly lies upon the interosseous muscle of the little finger.

Use.—To draw the ring finger towards the little finger.

The origins of most of these muscles are traversed by branches of arteries from the deep palmar arch.

Having given the origin and insertion of each muscle of the upper extremity, individually, it is important to consider the combined actions of the muscles of each joint, producing the extensive and various motions of the limb.

It may be well to recall to the recollection of the reader, that the upper extremity is principally connected to the body through the medium of those muscles which arise from the trunk, and are inserted into the clavicle and scapula; and that these muscles have the further office of fixing those bones before the arm can perform any powerful motion, while a *point d'appui* is always maintained by the attachment of the clavicles between the scapula and sternum. The shoulder is fixed by the equal action of seven muscles; two of which have already been described as serving to raise the scapula, three to carry it backwards, and two forwards.

By the separate action of these sets of muscles the scapula is either raised, drawn backwards or forwards, at the same time carrying the whole arm with it, and thereby increasing its field of motion. Independently of these direct movements, various combinations arise between the different sets of muscles, according to the varying points of direction in the movements of the scapula forwards, upwards, backwards and downwards: for instance, in reaching a book from a shelf above the head and in front of you, the

action would be performed principally, so far as regards the scapula, by the two muscles above, and the two in front.

The shoulder-joint is formed by the attachment of the humerus to the scapula—a joint possessing the most extensive motion of any in the body; hence the necessity of its numerous muscles.

The humerus moves upon the scapula in every direction; but its principal movements are, forwards and upwards, downwards and backwards, outwards, inwards, and rotatory; and, by the combination of all these motions, circumduction. Each of these individual motions is performed by a particular set of muscles; while infinite varieties are formed by their multiplied combinations.

The motion forwards and upwards, or extension of the humerus, is performed by the acromial and clavicular fibres of the deltoid, supra spinatus, infra spinatus, coraco brachialis, subscapularis, pectoralis major (by its clavicular portion), assisted by the biceps, a muscle of the elbow-joint.

It is the deltoid, supra spinatus, coraco brachialis, and the clavicular portion of the pectoralis major, which first raise the humerus; while the infra spinatus, subscapularis and biceps unite to fix it in a raised position.

All these extensors of the shoulder-joint, must necessarily be put upon the stretch in the dislocation of the head of the humerus into the axilla.

The motion backwards and downwards, or flexion of the humerus, is performed by the posterior fibres of the deltoid, teres major, teres minor, latissimus dorsi, and by the long head of the triceps,—a muscle of the elbow-joint.

In dislocation of the head of the humerus into the axilla, the deltoid and long head of the triceps will be put upon the stretch, the teretes relaxed, while the latissimus is but little altered from its quiescent position.

The motion outwards, or abduction of the arm, is performed by the deltoid, supra spinatus, and infra spinatus, assisted, when carried from the side, by the subscapularis.

The first three of these muscles mentioned as abductors, have been before described as extensors of the arm; in that motion being in co-operation with the adductors.

In dislocation of the head of the humerus downwards and backwards upon the venter of the scapula, the subscapularis muscle is frequently lacerated.

The motion inwards, or adduction, is performed by the pectoralis major and latissimus dorsi; this motion being rendered more perfect by the action of the trapezius, rhomboidei, and pectoralis minor, uniting to draw the scapula with the arm in the inward direction.

In dislocation of the head of the humerus into the axilla, these muscles are put upon the stretch by the consequent abduction of the arm.

Rotation outwards is performed by the supra spinatus, infra spinatus, teres minor, posterior fibres of the deltoid, and coraco brachialis.

Rotation inwards is performed by the action of the subscapularis, teres major, and clavicular portion of the deltoid.

Circumduction is described by the motion of the arm forming a cone, the apex of which is at the shoulder-joint, and the base at the extremity of the fingers; it is produced by the combined operation of all the muscles of the shoulder-joint in succession.

The articulation of the elbow forming a ginlymus joint, its motions are in two directions only: which, being less varied than in enarthrodial articulations, is effected by a less numerous arrangement of muscles.

These motions are flexion and extension.

In flexion of the fore arm, both the radius and ulna move upon the humerus; and this motion is principally performed by the biceps, and brachialis internus muscles, as the flexors; the triceps and anconeus, as the extensors; three of which are inserted into the ulna. Indeed, I think it will be found upon a strict and attentive examination of the elbow-joint, either in reference to the articulation of the bones, to the attachment of the ligaments, or, to the function of its

muscles, that the peculiar articulation of the radius with the humerus may be considered as passive, in relation to flexion and extension of the elbow-joint; and active only in relation to the superior radio ulnar articulation. Thus we may observe, that, during the performance of flexion and extension of the fore arm, the rotatory motion of the superior radio ulnar articulation may be continued as a separate and distinct action; proving, that, although the action relative to the elbow-joint is simultaneous, the function is for the distinct motion of a separate joint. And further, we may observe, that the principal strength of structure is maintained between the humerus and ulna, which are placed in a continued line with each other; while the radius diverges outwards from the elbow-joint to be connected with the carpus, and thus increases the range of motion of the hand.

The biceps muscle being attached to the radius, and not as the other three to the ulna, may be considered in its action for the purpose of drawing the head of the radius firmly upon the external condyle of the humerus, when powerful supination is required; and it is remarkable that the radius does not diverge from the ulna, until after the attachment of the biceps; by which construction, this point of insertion is placed in the line of direction in which the radius and ulna are capable of affording the greatest resistance. From these circumstances, the brachialis internus may be considered as the true flexor of the elbow; but when the radio ulnar articulation is in a state of supination, then the biceps is capable of acting, and adding considerable strength to the power of flexion. There are, however, several other muscles called into action, to maintain the elbow in a state of flexion; and these actions are variously modified according to the corresponding changes of exertions in the position of the limb. These muscles are the supinator radii longus, the flexor carpi radialis, the flexor carpi ulnaris, the palmaris longus, and pronator radii teres.

The extension of the elbow is produced by two muscles,

the triceps and anconeus,—both of them inserted into the ulna. This is an additional proof, that the biceps is not to be considered as a flexor of the elbow, as it has no antagonist muscle in that use.

It should here be observed, as a circumstance of considerable surgical importance, that as the long head of the triceps acts in carrying the humerus backwards, as well as in extension of the fore arm; it is necessary to flex the humerus in dislocations of the ulna backwards, to lessen the action of the triceps on the ulna.

What is termed pronation and supination of the hand, are positions produced by the rotatory motion of the radius upon the ulna; the hand being articulated with the radius, and moving with that bone.

These rotations are produced by the following muscles: *pronators*—pronator radii teres, and the pronator quadratus, principally, assisted however by the palmaris longus, and flexor carpi ulnaris; the two last act most powerfully when the wrist-joint is extended: *supinators*—the supinator radii longus, supinator radii brevis, the extensors proper to the thumb, and the biceps brachii. The muscles of the thumb acting with the greatest force when the thumb is directed into the palm of the hand, and the biceps at such a time when forcible supination is required, attended with flexion of the fore arm; and the action of this muscle is further increased by flexion of the humerus.

The only rotatory motion of which the ulna is capable, is in common with, but not upon, the humerus.

The wrist-joint is capable of being flexed, or extended, and allows the motion of the hand either towards the radius or ulna.

The flexors are, the flexor carpi radialis, flexor carpi ulnaris, palmaris longus, flexor sublimis et profundus digitorum, and the flexor tertii internodii pollicis. The first three are to be considered as the principal flexors of the wrist-joint; and the others only as acting secondarily when their contraction is continued beyond flexion of the fingers.

The extensors are, the extensores carpi radialis longior et brevior, extensor carpi ulnaris, the extensor tertii internodii, extensor indicis, and the common extensors to the fingers; it is however the first three of these muscles only which are to be considered as acting primarily upon the wrist-joint.

The inflection of the hand towards the radius, is produced by the action of the extensor primi internodii, or extensor ossis metacarpi, extensor secundi internodii (usually termed the primi), extensor carpi radialis longior and brevior, and the flexor carpi radialis.

The inflection of the hand towards the ulna, is produced by the extensor carpi ulnaris, extensor digitorum communis, more especially by that portion of tendon which passes to the little finger, the flexor carpi ulnaris and the common flexors of the fingers.

The slight degree of motion which takes place between the bones of the carpus and metacarpus, does not appear to be under the control of muscular contraction, but rather to depend upon the application of some external force; and is not therefore now to be considered further than as an illustration of the propriety of naming the first bone of the thumb as a phalanx, rather than as a metacarpal bone.

The motions of the thumb are produced by eight muscles, a flexor and extensor proper to each phalanx, and an abductor and adductor common to the three.

Thus the motions of the first phalanx upon the os trapezium are, flexion—by the flexor primi internodii, or ossis metacarpi; extension—by the extensor primi internodii, or extensor ossis metacarpi; abduction and adduction — by corresponding muscles: besides a rotatory motion, which is produced by the quick and successive action of each of these muscles.

The second phalanx only moves upon the first, in flexion and extension; and is furnished therefore with the flexor and extensor secundi internodii.

The third phalanx, precisely in the same manner, has its flexor and extensor, termed the tertii internodii.

The first phalanx of each finger differs from that of the thumb, in being connected with a metacarpal instead of a carpal bone, and having no other motion upon it, than the phalanges enjoy upon each other; namely, flexion and extension, and some slight degree of abduction and adduction.

Flexion of the first phalanges of all the fingers, is produced by the lumbricales; of the second, by the flexor sublimis perforatus; and of the third, by the flexor profundus perforans.

Extension of each phalanx of all the fingers, is produced by the extensor digitorum communis and interossei; the latter muscle also acting as their abductor and adductor.

The first phalanx of the fore finger, has however a considerable motion towards the thumb by the action of the abductor indicis, a muscle proper to that bone, unless it be considered, as some anatomists are inclined to believe, one of the interossei muscles.

The first phalanx of the little finger has also a motion from three muscles proper to it, independent of the muscles common to the other fingers; but it does not enjoy a greater variety, although an independent motion.

Practical Remarks.

With respect to the fractures and dislocations of the bones of the upper extremity, I have already treated of them in my description of the bones and ligaments. The axilla is a large space bounded in front by the pectoralis major, behind by the latissimus dorsi and teres major, above by the shoulder-joint, below by the free edges of the pectoralis major and latissimus dorsi, on the outer side by the arm, and on the inner by the serratus magnus covering the thorax. This space is filled up by a large portion of cellular membrane, by absorbent glands, and by the axillary artery, vein and nerves. Operations are frequently required in this cavity, from the formation of abscesses in the cellular membrane, diseases of the glands, and from diseases and injury to the vessels. It is necessary, in these operations, whether opening an abscess or extirpating a diseased gland, to direct the knife towards the

thorax, rather than towards the upper and posterior boundary of the axilla, in which direction the large vessels are situated, lying upon the tendons of the latissimus dorsi and teres major.

The brachial artery begins at the lower boundary of the axilla, and continues down along the inner side of the two upper thirds of the arm, after which it lies on the anterior surface of the inferior third; which course being remembered, the surgeon is thereby required to use particular caution in operating in that direction.

In abscesses under the fascia of the arm, attention must be paid to the precise situation of the matter, whether it be in the anterior or posterior fascial bag; if in the front cavity, the surgeon should direct his lancet anterior to the intermuscular tendons, leading on the outer side from the deltoid muscle to the external condyle, and on the inner side from the coraco brachialis to the internal condyle; the same respective attention is necessary if the abscess be situated in the posterior part of the arm.

The surgical remarks connected with venesection at the elbow, will be mentioned when treating of blood-vessels. Wounds of this part are of importance, from the proximity to the surface of its numerous vessels, and from the little protection the bones of this joint afford to them.

Wounds of the fore arm are of more importance on the anterior than the posterior surface, in consequence of the situation of the blood-vessels; and from their frequent division, the surgeon should be well acquainted with their relative position to the muscles. The operations necessary for securing these vessels will be given when treating of the arteries.

Abscesses of the hand are rendered dangerous from the thickness of the skin and fascia of the palm, which, being of so dense a nature, the process of ulceration goes on so slowly that violent constitutional symptoms arise from the confinement of the matter; and hence the necessity of early openings immediately fluctuation can be discovered.

LECTURE XVI.

DESCRIPTIVE ANATOMY OF MUSCLES.

Muscles of the Back.

Having described the muscles of the upper extremity, and in the progress of the dissection necessarily removed part of the muscles of the back, I shall now proceed to the remaining muscles of that region.

The subject being placed upon the abdomen, and the chest raised by blocks, the common integuments of the back should be dissected off, when a considerable layer of fascia will be exposed, giving more or less of a general covering to the subjacent muscles, and extending from the occiput to the pelvis. This aponeurotic expansion derives different names from the parts to which it is attached; hence it is termed the ligamentum nuchæ above, dorsal fascia in the middle, and lumbar fascia below; each of these parts requiring a separate description.

The ligamentum nuchæ, proceeds from the occiput to the sixth cervical vertebra; above it dips deeply down between the muscles, and separates those of the one side from the other; it seems to be formed of the aponeurotic origin of the muscles of this region, and assists in keeping the head erect, diminishing thereby the necessity of so great and constant a muscular action for that purpose. In quadrupeds it is much stronger and more distinct than in the human subject. From the termination of the ligamentum nuchæ, a broad aponeurosis expands laterally to the scapulæ, underneath the trapezii muscles, strengthening their fibres and binding down the muscles underneath; it reaches from the sixth cervical, to the fifth or sixth dorsal vertebra, dividing

itself into two layers, so as to give a posterior as well as an anterior covering to the trapezii. The lumbar fascia, which is the strongest, consists of three distinct layers; the posterior of which can only be seen in this progress of dissection, but the deeper seated ones may be afterwards traced to their attachments.

The posterior layer of the fascia lumborum is attached to the apices of the spinous processes of the sacrum, and posterior labium of the crista of the ilium; from below it proceeds upwards, being attached to the spinous processes of all the lumbar and the last dorsal vertebra, and forms in this situation a common origin to the latissimus dorsi, serratus posticus inferior, and obliquus abdominis internus muscles.

This fascia, as it presents itself to view upon the back, is of an oval form, being broader in the centre than at its two extremities.

The second layer arises from the apices of the transverse processes of the lumbar vertebræ, in common with the transversalis abdominis, where it is connected with the posterior layer so as to inclose the sacro lumbalis and longissimus dorsi in a complete aponeurotic sheath, between the spinous and transverse processes of the vertebræ.

The third layer is attached to the roots of the transverse processes of the lumbar vertebræ, passes in front of the quadratus lumborum, being placed between it and the peritoneum, proceeds upwards as far as the inferior edge of the last rib, where it is attached to the ligamentum arcuatum, and below terminating on the crista ilii; this layer also proceeds to the apices of the transverse processes, and is there connected with the other two layers, so that at this point, which is at the posterior termination of the transversalis muscle, it may be said that the fascia lumborum divides into its three layers; the anterior one to be attached to the roots, the middle one to the apices of the transverse processes, and the posterior one to the spinous processes of all the lumbar vertebræ.

Use.—The use of the fascia lumborum is to give origin to muscles, and to afford a general support to the loins, by maintaining in some measure the equilibrium of the body without the aid of muscle.

This fascia being examined we may proceed to the dissection of the extensive mass of muscles which is found in this region of the body, and which, for facility of description, is divided into seven layers.

The first layer is composed of the m. trapezius and latissimus dorsi, which have already been described; the former attaching the scapula, and the latter the os humeri, to the trunk.

The second layer is composed of the rhomboidei and levator scapulæ; each of these have also been described as attaching the scapula to the trunk.

We now proceed to the third layer, which consists of two muscles, the serrati postici, both being muscles of respiration, and have not therefore in my arrangement been hitherto described.

The *m. serratus posticus superior—arises* by a tendon common to it, the rhomboidei, the trapezius, and the splenius muscles; from the spinous processes of the three inferior cervical, and the two or three superior dorsal vertebræ: from these origins it soon becomes muscular, and passes downwards and outwards to be *inserted* by distinct fleshy fibres into the second, third, fourth, and fifth ribs, anterior to their angles.

This thin square muscle is covered by the trapezius and rhomboideus; it covers part of the splenius, longissimus dorsi, sacro lumbalis, ribs, and external intercostal muscles.

Use.—To raise the ribs, and consequently to increase the capacity of the chest.

The *m. serratus posticus inferior—arises* by a broad thin tendon from the spinous processes of the three last dorsal and the three superior lumbar vertebræ, in connection with the fascia lumborum; this tendon proceeds obliquely upwards and outwards across the longissimus dorsi and sacro

lumbalis, and then becomes fleshy, dividing into four distinct bundles which are *inserted* into the four inferior ribs; the inferior portion being the narrowest and the longest, extends as far as the cartilage of the last rib, while the others are inserted between the angles and the cartilages.

This thin broad muscle is covered by the latissimus dorsi; it rests upon the sacro lumbalis, longissimus dorsi, upon the three last ribs, and their corresponding external intercostal muscles.

Use.—To depress the lower ribs; to act therefore as an antagonist to the preceding muscle in diminishing the capacity of the chest.

These muscles being removed, the fourth layer will be exposed, consisting of a vast mass of muscle bounded above by the occiput, below by the pelvis, on the inner side by the spinous processes of the vertebræ, and on the outer side by the angles of the ribs, and are principally for the purpose of keeping the head and trunk erect; and many of them are muscles of violent expiration. It is necessary to subdivide this layer into three, consistent with my arrangement of dividing the muscles of the back into seven; although their precise origin is often arbitrary. The muscles which are completely exposed in this fourth layer are, below, the sacro lumbalis, longissimus dorsi, and spinalis dorsi; above, the splenius.

The *m. sacro lumbalis*—forms the outer boundary of the erector muscles of the spine; it *arises* by a broad tendon from the spinous processes and posterior part of the sacrum, from the posterior labium of the ilium, reaching nearly to the middle of its crista, also from the spinous and roots of the transverse processes of all the lumbar vertebræ; from these origins this muscle proceeds upwards and slightly outwards to be *inserted,* by long and thin tendons, into all the ribs, near their angles—the superior tendons being the longest. From the upper part of the six lower ribs, distinct bundles of fleshy fibres *arise,* which pass upwards to be attached to the inner side of this muscle; these are termed the musculi accessorii ad sacro lumbalem.

The *m. longissimus dorsi*—*arises* precisely by the same attachments with the last described muscle, passes inseparably with it to the last rib, where they diverge, to be *inserted* by tendinous and fleshy fibres into the lower edge of all the ribs, excepting the two last, in a space between their tubercles and angles, and into the transverse processes of all the dorsal vertebræ, by small double tendons; the insertions into the ribs proceed from the outer edge of the muscle, and into the transverse processes from the inner.

These muscles are situated underneath the latissimus dorsi, trapezius, rhomboidei, and serrati, and occupy a space between the spinous and transverse processes of the vertebræ.

Use.—To assist in preserving the erect position of the trunk, turning it to one side; or, in violent expiration, to diminish the capacity of the chest, by drawing down the ribs.

The *m. spinalis dorsi*—is exposed by turning the longissimus dorsi outwards from the spine; it forms the innermost fasciculi of the erector mass of muscle of the trunk, *arising* tendinous and fleshy from the spinous processes of the two superior lumbar, and the three inferior dorsal vertebræ; it proceeds upwards, in contact with the bones of the spine, to be *inserted* tendinous into the spinous processes of all the dorsal vertebræ above the ninth, excepting the first.

The situation of this muscle is between the longissimus dorsi and spinous processes of the vertebræ.

Use.—Together with the preceding to keep the trunk erect.

The *m. splenius*—*arises* tendinous from the spinous processes of the five inferior cervical and the four superior dorsal vertebræ; from these origins the fibres pass upwards and outwards, divide themselves into two portions—the upper one, which is by some anatomists termed the splenius capitis, to be *inserted* tendinous into the back part of the mastoid process of the temporal bone, and into the occipital bone immediately below the superior transverse ridge; the lower portion, frequently called the splenius colli, is *inserted*

into the transverse processes of the three or four superior cervical vertebræ by distinct tendons.

The origin of this muscle is covered by the trapezius, rhomboidei, and serratus posticus superior.

The occipital insertion of this muscle is covered partly by the sterno cleido mastoideus, partly by the trapezius; the remaining portion being seen between them and the cervical insertion.

The cervical insertion is covered by the same muscles as its origin, and its tendons placed immediately behind the cervicalis ascendens and the levator scapulæ.

Use.—This muscle assists in keeping the head and cervical vertebræ erect, and to draw them backwards, either obliquely or directly as one or both muscles act.

The splenius should now be carefully removed to expose the muscles of the fifth layer of the back, which are situated on the upper part of the spine, and consequently covered by this muscle. This layer consists of the cervicalis ascendens, transversalis colli, trachelo mastoideus, and complexus; and are placed in the above order, beginning from the outer side and proceeding towards the inner or spinous processes.

The *m. cervicalis ascendens*, or more commonly called *descendens*—seems as if it were a continuation of the sacro lumbalis muscle, being directly continuous with its tendinous insertions, but is described as separately *arising* by distinct tendons from the upper edge of the four or five superior ribs; it soon forms thin fleshy fasciculi, which ascend, to be *inserted* by distinct tendons into the transverse processes of the fourth, fifth, and sixth cervical vertebræ.

The origin of this muscle is placed between the insertions of the sacro lumbalis on its outer side, and the longissimus dorsi on the inner, is covered by the rhomboideus; its insertion is placed between the splenius colli and levator scapulæ, and is the same, as far as refers to its attachment, as the origin of the scalenus anticus.

Use.—To turn the neck obliquely if one acts, or to steady the neck, and consequently the head, if they both act.

The *m. transversalis colli*—has the appearance of arising from the insertions of the longissimus dorsi, as the cervicalis ascendens does from the sacro lumbalis; but by dissection it will be found to *arise* on the inner side of the tendons of that muscle, from the transverse processes of the five superior dorsal vertebræ, by distinct fleshy and tendinous slips, and passes upwards to be *inserted* tendinous into the transverse processes of the five inferior cervical vertebræ.

The belly of this muscle lies between the cervicalis ascendens, which is situated on its outer side, and the trachelo mastoideus on its inner.

Use.—To bend the neck to one side, and direct it obliquely backwards.

The *m. trachelo mastoideus*—is a slender flattened muscle, which *arises*, partly tendinous and partly fleshy, from the transverse processes of the five inferior cervical and the two or three superior dorsal vertebræ. The fleshy fibres ascend vertically in the neck, and soon form one fleshy belly, which is directed outwards to be *inserted* tendinous into the posterior part of the mastoid process of the temporal bone.

This muscle is placed on the inner side of the transversalis colli, which partly covers its origin, and on the outer side of the complexus. It covers at its upper part, in its passage to the mastoid process, the obliqui capitis and the origin of the posterior belly of the digastricus. It is covered by the splenius and levator scapulæ.

Use.—To keep the head erect when both muscles act, and to draw it backwards, or to one side, if one only is in action.

The *m. complexus*—*arises* by tendinous and fleshy fibres from the transverse and articular processes of the four or five inferior cervical, and from the transverse processes of the seven superior dorsal vertebræ, gaining a fleshy fasciculus from the spinous process of the first dorsal vertebra; from these origins it soon forms one large fleshy muscle, which passes upwards, slightly converging towards the mus-

cle of the opposite side, and is *inserted* into the rough surface on either side of the protuberance between the two transverse ridges of the occipital bone.

The complexus is covered successively by the trapezius, splenius, and trachelo mastoideus; it is situated between that muscle and the spine, being separated from its fellow by the spinous processes. It lies upon the semi-spinalis colli, upon the rectus capitis posticus major, and the obliqui; between this muscle and the semi-spinalis colli is placed the deep cervical branch of the subclavian artery, anastamosing with the occipital. A large portion of this muscle is seen between the splenius and the spine upon the removal of the trapezius.

Use.—To draw the head backwards, and to support it on the spine, also to rotate it; being in this action an auxiliary to the sterno cleido mastoideus of its own side.

The sixth layer of muscles of the back consist of the rectus capitis posticus major, the rectus capitis posticus minor, the obliquus superior, the obliquus inferior, the semi-spinalis colli, and the semi-spinalis dorsi.

The *m. rectus capitis posticus major*—is a triangular muscle, and is much broader above than below. It *arises* from the spinous process of the vertebra dentata, from whence it ascends, passing outwards to be *inserted* under the inferior transverse spine of the occiput, between the rectus capitis posticus minor, and the obliquus superior, the insertion of which partly covers it.

This muscle is situated between the occiput and the neck, is covered by the complexus, and lies upon the rectus minor, the arch of the atlas, the posterior circular ligament, and the vertebral artery.

Use.—To draw the head backwards, and to one side, if only one acts; directly backwards, if they both act.

The *m. rectus capitis posticus minor*—*arises* from a small tubercle upon the posterior arch of the atlas, which corresponds to the spinous process of the other vertebræ; from thence it passes upwards nearly vertically, becoming broader

as it ascends, and is *inserted* into the occipital bone, in a space between the inferior transverse ridge and the foramen magnum.

Its posterior surface is partly covered by the rectus capitis posticus major; but a portion on the inner side is left uncovered by that muscle, and is in contact with the complexus; its anterior surface lies upon the posterior circular ligament, vertebral artery, and occipital bone.

Use.—To assist the preceding muscle in drawing the head backwards.

The *m. obliquus capitis superior—arises* tendinous from the posterior and upper part of the extremity of the transverse process of the first cervical vertebra; from this origin it forms an elongated muscle, which becomes broader as it ascends, and passes inwards to be *inserted* by tendinous fibres into the inferior transverse ridge of the occiput, sometimes reaching as far as the mastoid process.

This muscle is situated between the atlas and occiput; it is covered by the complexus and splenius; it covers the posterior circular ligament, the vertebral artery, and the occipital bone; at its insertion it conceals some of the fibres of the rectus capitis posticus major. A triangular space is seen between this muscle and the rectus capitis major, in which is placed the vertebral artery and suboccipital nerve.

Use.—When both muscles are in action, it draws the head backwards; it directs it, when singly, to that side on which the muscle is exerted.

The *m. obliquus capitis inferior—arises* tendinous and fleshy from the extremity of the spinous process of the second cervical vertebra; it then passes obliquely upwards, forwards, and outwards to be *inserted* by short tendinous fibres into the posterior and inferior surface of the transverse process of the atlas.

This muscle is covered by the complexus and trachelo mastoideus, excepting a small portion which is seen between them; its origin is covered by the origin of the rectus capitis posticus major.

Use.—To rotate the atlas, and with it the head upon the vertebra dentata, assisted by the splenius of the same side, and the sterno cleido mastoideus of the opposite.

The *m. semi-spinalis colli*—is not seen until the complexus is either raised or turned outwards. It *arises* by six tendons from the transverse processes of the six superior dorsal vertebræ; it ascends, passing obliquely inwards under the complexus, to be *inserted* into all the spinous processes of the cervical vertebræ, excepting the first and the last. Such are the attachments usually assigned by anatomists; but these are rendered difficult to dissect from their intimate union with other muscles.

This muscle is placed between the complexus and spinous processes of the vertebræ, to which it is attached; it is covered by the complexus, tendons of the longissimus dorsi, and in its middle part by the serratus superior.

Use.—To extend the neck, and to give it an oblique direction to either side, according to the action of either muscle.

The *m. semi-spinalis dorsi*—*arises* tendinous and fleshy from the transverse processes of the seventh, eighth, and ninth dorsal vertebræ, passes vertically upwards to be *inserted* by distinct tendons into the spinous processes of the five superior dorsal, and the two inferior cervical vertebræ.

The origin of this muscle is placed on the outer side of the insertions of the spinalis dorsi, and its upper attachments are on the inner side of the lower part of the semi-spinalis colli.

This muscle is covered by the longissimus dorsi.

Use.—To extend the spine either directly or obliquely backwards, depending on the action of one or both these muscles.

The seventh and last layer of the muscles of the back, consists of the multifidi spinæ, the interspinales, and the intertransversales.

The *m. multifidi spinæ*—extend from the sacrum to the second cervical vertebra, forming a chain of small muscles situated between the transverse and spinous processes. They pass upwards in an oblique direction, and gradually

diminish in bulk as they ascend. They are of an unequal length, and intimately connected with each other; in some instances the origin and insertion extend only from one vertebra to the next, in others extend over two or three vertebræ, before they are inserted.

The multifidi spinæ *arise* from the spinous processes and posterior surface of the sacrum, and adjoining portion of the ilium; from the articular and transverse processes of all the lumbar, from the transverse processes of all the dorsal and cervical vertebræ, excepting the three uppermost; from these several origins, the fibres separate into distinct fasciculi to be *inserted* tendinous into the spinous processes of all the lumbar, dorsal, and cervical vertebræ, excepting the first.

These muscles are deeply seated, lying on the bones of the spine, and are covered by the semi-spinalis dorsi and the semi-spinalis colli.

Use.—To support and extend the spinal column obliquely, when the muscles of one side act; and also to give some slight rotatory motion of one vertebra upon another.

The *m. interspinales*—are small fasciculi of muscular fibres placed, as their name implies, between the spinous processes of all the vertebræ, and are divided into the interspinales cervicis, dorsi, et lumborum.

The *m. interspinales cervicis.*—In consequence of the bifurcation of the spinous processes of these vertebræ, the interspinal muscles are usually described as being double, a separate fasciculus being connected with each portion of the divided process; they are contracted at each extremity, and thickest in their centre. These muscles sometimes are continuous for the length of three or four vertebræ, and in other subjects distinct.

Use.—To draw the spinous processes of the cervical vertebræ towards each other, and consequently to extend the neck.

The *m. interspinales dorsi*—are much less distinct than the preceding muscles, and indeed are frequently wanting;

the lower five or six of the dorsal vertebræ have them usually the most distinct; when found, they are placed more by the sides of the spinous processes than at their apices, and seem as if they were portions of the attachment of other muscles rather than distinct muscles themselves.

Use.—The same as the last described.

The *m. interspinales lumborum*—are usually six in number ; the first being between the spinous process of the last dorsal and the first lumbar vertebra, and the sixth between the sacrum and the last lumbar. In this region, as in the dorsal, they are placed more by the sides of the spinous processes than in the cervical region.

Having finished the muscles situated upon the posterior part of the spine, in order to complete the muscles of the spinal column, we will now proceed to those situated upon its anterior and lateral surfaces.

Deeply seated on the anterior surface of the neck are three muscles, which are exposed by removing the pharynx and larynx. The first of these—

The *m. longus colli.*—This muscle is peculiar from its origin being within the thorax, and passing out of the upper opening of the chest, extending from the third dorsal vertebra to the atlas. It *arises* tendinous and fleshy from the lateral surface of the bodies of the three superior dorsal vertebræ, and also from the anterior surface of the roots of the transverse processes of the four or five inferior cervical vertebræ ; the fibres ascend obliquely inwards, adhering to the bones and intervertebral substances, and pass to be *inserted* tendinous and fleshy into the fore part of the bodies of all the vertebræ of the neck.

This muscle is covered by the pharynx, larynx, œsophagus, carotid sheath, and its contents ; it lies upon the vertebræ and intervertebral substances ; just where it emanates from the thorax it is placed on the inner side of the scalenus anticus muscle, between which a space is left which contains the vertebral artery, vein, and some filaments of the sympathetic nerve.

Use.—To bend the neck slightly forwards, and give some little rotatory motion of the atlas upon the second cervical vertebra.

The *m. rectus capitis anticus major.*—This muscle extends from the sixth cervical vertebra to the occiput; it *arises* tendinous from the transverse processes of the third, fourth, fifth and sixth cervical vertebræ, proceeds upwards and inwards, becoming broader as it ascends, and is *inserted* into the cuneiform process of the occipital bone, behind the attachment of the pharynx, reaching as far outwards as the condyloid process.

This muscle is covered by the carotid sheath and its contents, by the pharynx, larynx, and œsophagus; it lies partly upon the longus colli, rectus capitis anticus minor, and the articulations between the first and second cervical vertebræ; it is placed between the scaleni and longus colli.

Use.—To move the head slightly forwards, or laterally upon the atlas, according to the action of one or both muscles.

The *m. rectus capitis anticus minor*—is shorter and narrower than the preceding muscle; it *arises* tendinous below from the anterior part of the root of the transverse process of the atlas; from thence it expands as it ascends to be *inserted* into that portion of the cuneiform process of the occipital bone which forms the anterior margin of the foramen magnum, reaching as far laterally as the junction of the petrous portion of the temporal bone with the basilar process of the occipital.

It is covered by the rectus capitis anticus major; it covers the articulation between the atlas and occiput.

Use.—To assist the last described muscle in bringing the head forwards.

The muscles situated upon the lateral aspects of the spine, are the rectus capitis lateralis, the scaleni, the intertransversales, and the quadratus lumborum; the latter muscle, however, I shall not describe, for the convenience of dissection, until treating of those arising from within the pelvis.

The *m. rectus capitis lateralis—arises* by a small tendon from the superior and anterior part of the transverse process of the atlas, aud ascends vertically to be *inserted* into a small process on the occipital bone, immediately behind the fossa jugularis.

The situation of this muscle is between the internal jugular vein, which is anterior to it; and the vertebral artery, which is behind it.

Use.—To incline the head laterally and slightly forwards.

The *m. scalenus anticus—arises* tendinous from the anterior part of the transverse processes of the third, fourth, fifth, and sixth cervical vertebræ; it forms a thick fleshy muscle, which passes downwards to be *inserted* tendinous into a small tubercle situated upon the upper and anterior surface of the middle part of the first rib.

This muscle is deeply seated, and is coverèd by the sterno cleido mastoideus, and omo hyoideus muscles; its insertion is crossed by the subclavian vein, above which, it is also crossed by the superficial cervical artery; in the direction of its long axis there rests upon the muscle the phrenic nerve, and the ascending cervical artery; behind it, is placed the subclavian artery, so that the scalenus anticus muscle separates the subclavian artery from the subclavian vein; the outer side is bounded by the cervical nerves, as they are passing to form the axillary plexus, and the inner side by the vertebral artery.

Use.—To bend the cervical vertebræ laterally and forwards, and to assist in inspiration by raising the rib, fixing it as a point for the action of the intercostal muscles.

The *m. scalenus medius—arises* tendinous from the transverse processes of all the cervical vertebræ; these origins soon become fleshy, and pass downwards as one large muscle to be *inserted* into the upper and outer part of the first rib, about half an inch anterior to its angle, behind the subclavian artery.

This muscle is separated from the preceding, below, by the subclavian artery, and above, by the cervical nerves.

Use.—To bend the neck, and assist in inspiration with the anterior muscle; but it also assists in drawing the vertebral column a little backwards.

The *m. scalenus posticus—arises* tendinous from the posterior part of the transverse processes of the fifth and sixth, and sometimes from the fourth cervical vertebra; from these origins the muscle descends behind the former, and passes to be *inserted* into the obtuse edge of the second rib, between its tubercle and angle.

It is sometimes separated from the scalenus medius by some branches of the inferior cervical nerves; but more frequently the fibres of the two muscles are only distinct from each other at their insertions. This muscle is bounded posteriorly by the transversalis colli and splenius.

Use.—To raise the second rib during inspiration, and to extend the neck laterally.

Continuing downwards from the vertebral attachment of the rectus capitis lateralis to the sacrum, and situated between the transverse processes, are found muscles which are named, from their position, the intertransversales, and are subdivided into those of the neck, the back, and the loins.

The *m. intertransversales cervicis*—in consequence of the bifid termination of the transverse processes of the cervical vertebræ, are divided into an anterior and a posterior layer, proceeding from the first to the last vertebra of the neck: the attachment of the rectus capitis lateralis is continuous with these muscles.

Use.—To curve the spine laterally to the side on which they are in action.

The *m. intertransversales dorsi*—are much less distinct than in the cervical region, are usually larger in the lower dorsal vertebræ than the upper, as if they arose fleshy from the five or six inferior, to be inserted tendinous into the five or six upper vertebræ of the neck.

Use.—To draw, in some slight degree, the transverse processes of the vertebræ of the back towards each other.

The *m. intertransversales lumborum*—are intermediate in size, between those of the cervical and dorsal regions; are

otherwise precisely similar to them; the fifth or lower one is attached to the lateral portion of the sacrum, and sacro lumbar ligament.

Use.—To draw the transverse processes of the lumbar vertebræ towards each other.

From the foregoing description of muscles of the spine, with their multiplied attachments, we perceive, that the motions of the spinal column are calculated to combine great strength with considerable variety of action. The inflections are, forwards, backwards, and laterally, together with intermediate modifications; in all of which the opposite muscles act as antagonists. For instance, in bending the body forwards, numerous muscles act in producing that motion; while at the same time, other muscles are called equally into action to prevent the column turning to either side, thereby fixing and supporting the bones. Again, in preserving the equilibrium of the body in all its motions, a vast number of muscles are called into action, merely to preserve its eliquibrium; hence there is almost an inconceivable variety in the combined actions of the muscles of the spinal column, all of which are more or less assisted, or are in connection with those of the trunk.

Before motion in any one part of the spinal column can take place, another portion must be fixed by a certain set of muscles, which are termed the fixors, and form a fulcrum of support for those muscles which are called into action as the motors of the part destined to be moved.

The motions of the spine may be considered with regard to its action generally, and to the actions of its particular regions.

Under the first consideration we may observe, that the erect position of the body is maintained by the simultaneous action of all those muscles which have been described as connected with the spine, on its anterior, posterior, and lateral regions; assisted also by the muscles of the abdomen, pelvis, and extremities.

The principal deviations from the erect position are, in

the motions of the body forwards, backwards, or to either side.

When the body is bent forwards, the muscles of the lower extremities first act upon the pelvis, so as to form a fulcrum for the spinal column. The column itself is bent forwards by the rectus capitis anticus major, and minor, the longus colli, pectorales, serrati magni, abdominal muscles, and the psoæ; but it is to be remembered, that all these muscles do not immediately act upon the spinal column. For instance, the recti muscles of the head will only tend to flex the cervical region of the spine, after they have drawn the head to the full extent of their action forwards; while the longus colli, being only connected with the bones of the spine, act directly upon them. Again, the pectorales and serrati do not act upon the spine, until the ribs and upper extremities are first fixed by other muscles; in the same manner the abdominal muscles require the pelvis and ribs to combine in forming a fixed point, before they can act upon the spine; while the psoæ again act directly upon the column, when the pelvis forms a fixed point. To these muscles might be added several others; as, for instance, those placed between the sternum and os hyoides: but I shall not enumerate them in the general action of the spine, as their motions are very remote, although not wholly unconnected with it.

The spine is drawn backwards principally by the sacro lumbales, longissimi dorsi, spinales dorsi, semi-spinales dorsi, and multifidi spinæ; assisted by the trapezii, rhomboidei, latissimi dorsi, and serrati postici; the latter muscles acting through the medium of the upper extremities and ribs. It is essential to remember, that in the motions of the spine either forwards or backwards, the muscles in both regions are in reciprocal action. When the body is bent forwards, the posterior muscles act as antagonists, and modify the extent of action in the flexors; when the spine is bent backwards, then the flexors have a reciprocal action as antagonists to the extensors. The extensors of the spine are larger and more numerous than the flexors, having to

support the greater weight of the head and viscera in front, and to counterbalance the preponderating direction of the body forwards.

The lateral directions of the spine are immediately produced by the recti capitis laterales, the scaleni, the intertransversales, and quadrati lumborum; assisted, however, by the flexors and extensors, when they act on one side only. The oblique insertion of the tendons adds considerable strength, as well as variety, in the directions of the lateral motions of the spinal column.

When the hand is grasping any fixed body firmly, the lateral motions of the spine are also assisted by the muscles of the upper extremity.

The rotatory motions of the spine are inconsiderable, and are even doubted by some physiologists; but in the lumbar region, the construction of the articular processes evidently admits of a slight rotatory motion, and may occur from the combined and successive action of the muscles of this part.

Practical Remarks.

Reflecting upon the construction of the vertebral column, and the various actions of its muscles in supporting the weight of the body, it is evident, that any deviation from the natural perpendicular direction of the spine would at once derange the natural position of the muscles, cause pressure on the spinal marrow, and consequent morbid action in the system.

Contortions of the spine most frequently occur from disease of the bone. In scrofula and rickets, their structure is softened and rendered less capable of supporting their superincumbent weight; the bones then yield according to the extent of the disease, throwing the body out of its natural position. The muscles of the two sides of the spine, in consequence, do not act equally; which tends materially to increase the contortion, by their constant endeavour to maintain the central line of gravity: a second curve is thus produced in an opposite direction to the primary deviation. These circumstances point out to the surgeon the necessity of his earliest attention, in diseases of the spine, to counteract their baneful effects: the symptoms of which seem naturally to indicate the propriety of using every means of improving the general health, of diminishing the superincumbent weight; and, from his knowledge of the physiology and functions of muscles, of making them,

by judicious position, and perhaps motion, the active means of restoring the natural position of the bones.

With respect to the first indication, the improvement of the general health, it is necessary that the surgeon's attention should be directed to the state of the digestive organs, to the quality of food, and the salubrity of the air; mechanical means adopted to lessen superincumbent weight, as the inclined plane, &c., are of no avail whatever, and often are highly injurious, if at the same time the means of improving the general health be not attended to. With regard to position and motion, in relation to muscular action, no general plan can be laid down, as it must depend upon the peculiarities of each individual case.

Diseases of the spine frequently produce lumbar abscesses; and according to the direction which the matter takes between the layers of the lumbar fascia, they are named either lumbar, inguinal, or psoas: these are insidious in their progress, and often form large collections of matter, with very little concomitant constitutional derangement. As far as my experience extends, I doubt the propriety of opening these abscesses, as they are generally followed by hectic and dangerous symptoms.

As the most convenient progress of dissection, I shall now proceed to the remaining muscles connected with the thorax, which are expressly concerned in the function of respiration; while those which I have before given in connection with the chest, were only secondary in respiration, having to assist in other functions with which they are connected.

These muscles are, the intercostales, situated between the ribs; the triangularis sterni, on the inner surface of the sternum; the diaphragm, which separates the thorax from the abdominal cavity; and the quadratus lumborum, situated within the abdomen.

The m. intercostales, consist of twelve pairs on each side of the chest, and, with the ribs and sternum, form the paparietes of that cavity; they are arranged in two layers, denominated the m. intercostales externi and interni.

The *m. intercostales externi*—are twelve in number, and proceed from the transverse processes of the vertebræ, as far forwards as the cartilage of each rib. They *arise* from the transverse processes of all the dorsal vertebræ, and from the acute edge of each superior rib; their fibres pass

obliquely downwards and forwards,—those of the upper intercostal spaces being less oblique than those of the lower, and are also more oblique posteriorly than anteriorly; they are *inserted* into the upper obtuse edge of each inferior rib by short aponeurotic fibres, intimately connected with the periosteum as far as the cartilages of the ribs. The small fleshy bundles which arise from the transverse processes, are inserted partly into the rib connected with that vertebra, and partly into the next rib below; these are described as the *levatores costarum breviores et longiores,* and may be seen in the dissection of the muscles of the seventh layer of the back; but they are, in fact, merely the commencement of the intercostales externi.

These muscles are covered posteriorly by the serrati postici, longissimi dorsi, and sacro lumbales; anteriorly and above, by the pectorales; below, by the abdominal muscles; and in the middle, by the serrati magni: their internal surfaces are in contact with the pleura, from the tubercles of the ribs to their angles; and anterior to this they lie upon the internal intercostal muscles and vessels.

The *m. intercostales interni*—are twelve in number, and pass from before to behind, but with less obliquity than the external intercostal muscles. They *arise* from the lower edge of the cartilages of the ribs, commencing at their connection with the sternum, from the inferior edge of the body of each superior rib, extending as far as the angle, and pass downwards to be *inserted* into the upper edge of each inferior rib and cartilage. From the seventh to the eleventh rib, at about their centre, slips of the internal intercostal muscles, instead of being inserted into the rib immediately below, pass over it to be inserted into the second rib below; these muscles have received the name of *depressores costarum,* which evidently is an error; as, from the direction of their fibres, they cannot have a different action from the remaining portions of the internal intercostals.

The intercostal muscles decussate, forming a double layer in the centre of the ribs; and a single layer only from

the sternum to the junction of the cartilages with the ribs before, and from the angle of the ribs to the transverse processes of the vertebræ behind.

The external surface of the internal intercostal muscles is covered by the preceding, as far as the cartilages of the ribs, and in their interspaces by the pectorales and abdominal muscles; the internal surface is lined by the pleura.

Use.—To elevate the ribs in conjunction with the external intercostal muscles. The decussation of these muscles, and the oblique direction of their fibres, serve to approximate the ribs more completely than if their fibres had passed perpendicularly; for this oblique direction allows of a greater length of muscular fibre, while their decussation balances a consequent loss of power, and at the same time maintains a perpendicular elevation of the ribs.

The *m. triangularis sterni*—is situated within the cavity of the chest, upon the posterior surface of the sternum; it *arises* tendinous and fleshy from the ensiform cartilage, and the edge of the lower half of the middle pair of the sternum; from thence it ascends, passing obliquely outwards, to be *inserted* tendinous into the cartilages of the third, fourth, fifth, and sometimes sixth ribs, corresponding precisely with the origin of the pectoralis minor, to which it is an antagonist in respiration.

This muscle is covered by the sternum, cartilages of the last four true ribs, internal intercostal muscles, and internal mammary artery; it rests upon the pleura.

Use.—To draw the ribs inwards and downward, it thus diminishes the capacity of the thorax in expiration.

The *diaphragma* — or transverse septum between the thorax and the abdomen, is composed of two fleshy portions with an intervening tendinous expansion. Its figure is circular, convex upon its upper surface, projecting into the chest; concave below, forming the upper boundary, and enlarging the cavity of the abdomen. Its direction is from above to below, and from before to behind; so as to render the posterior vertical dimensions of the chest much more capacious than the anterior. The anterior portion, or larger muscle, principally forms the partition between the two

cavities. It *arises* from the posterior surface of the ensiform cartilage of the sternum, from the cartilages of the six or seven inferior ribs, and from the ligamentum arcuatum; from these attachments its fibres converge, and are *inserted* into a tendinous centre, which is termed the cordiform tendon of the diaphragm.

The lesser muscle, or abdominal portion of the diaphragm, *arises* tendinous on each side of the bodies of the four superior lumbar vertebræ, forming what are termed the cruræ of the diaphragm, of which the right is the larger and longer. These cruræ are at first separated from each other, leaving a narrow triangular aperture through which the aorta, vena azygos, and thoracic duct pass. The fibres of the lesser muscle then unite, decussate, again separate, and lastly, converge to be *inserted* into the cordiform tendon; leaving an elliptical opening between the points of decussation and insertion, for the passage of the œsophagus and par vagum.

The central, or cordiform tendon, is notched behind towards the vertebral column, and pointed anteriorly, so as more or less to resemble the form of a heart, from which it is has gained its name. Its fibres are of a tendinous lustre, and are more dense and distinct upon the upper than on the lower surface. A little to the right of its centre, and near the vertebral column, is an irregular triangular opening, through which the vena cava inferior passes, accompanied with filaments of the phrenic nerve. The four anterior fifths of the circumference of this tendon gives insertion to the larger muscle of the diaphragm, and the posterior fifth to the smaller muscle.

The upper convex surface of the diaphragm is covered by the pleura on each side, and by the pericardium in the centre, to which it is strongly attached; it also supports the base of the lungs. Its circumference anteriorly, is bounded by the triangularis sterni; laterally, by the internal intercostal muscles; and posteriorly, by the aorta, psoas, and quadratus lumborum muscles.

Its under surface is irregularly concave, and inclined forwards, its greatest concavity being over the liver; it is lined by peritoneum, and corresponds to the upper surfaces of the liver, stomach, spleen, pancreas, duodenum, kidneys, and capsulæ renales.

Use.—The diaphragm is the principal muscle of inspiration, and increases the capacity of the chest inferiorly, by having its convexity brought to a plane during its contraction; when it relaxes from this state, it is again forced upwards into the thorax by the pressure of the abdominal muscles, and the viscera underneath it. The œsophagus may be compressed by the contraction of the diaphragm, as it passes through its fleshy substance; while the aorta, vena cava, and other important organs, are protected from pressure by the arrangement of its tendinous fibres. Various phenomena arise from the action of this muscle upon the contents of the thoracic and abdominal cavities:—with respect to the lungs, sighing, yawning, coughing, laughing, sneezing, hiccough, and speaking; and in reference to the abdominal viscera, its motions contribute to the expulsion of the fœtus, urine, and fæces; and in consequence of its connection with the organs of digestion, and the chilopoetic viscera, it may assist in the performance of their functions.

The *m. quadratus lumborum.*—This muscle has already been named as one of those which are connected with the lateral aspects of the spine; but its origin and insertion was not described at the same time as the other muscles of that region, in consequence of its being situated within the abdominal cavity; but it may now be given consistently both with its function as a muscle of respiration, and with its situation.

It *arises* tendinous and fleshy from the posterior third of the middle labium of the ilium, and from the ilio lumbar ligament; from these origins the fleshy fibres ascend, to be *inserted* into the internal surface of the posterior half of the last rib, and into the transverse processes of the four superior lumbar, and the last dorsal vertebræ.

This muscle is placed between the diaphragm, which is anterior to, and partly covers it; and the sacro lumbalis, which is behind it: it is inclosed between the anterior and middle lamina of the fascia lumborum. The psoas magnus muscle, and the kidney are also anterior to it.

Use.—To bend the spine, and with it the thorax, laterally towards the pelvis; to draw down the last rib in expiration; and, if both muscles act, also to support the spine in the erect position of the body.

Having now described all the muscles which are connected with the ribs, without adverting particularly to their office in the function of respiration, it is necessary now to speak of their important action in the elevation and depression of those bones.

It may be observed, that respiration consists of the passage of a certain quantity of air into the lungs, termed inspiration ; and the expulsion of a similar quantity, named expiration. The lungs, the receptacle of the air we breathe, are contained laterally within the thorax; the enlargement of which to admit of the increased volume of the lungs during inspiration, and its contraction during expiration, constitute the act of respiration. The motion of the ribs upon the spine, admit of the enlargement of the chest in the following manner:—Laterally, by the turning outwards, and elevation of the bodies of the ribs ; anteriorly, by the thrusting forwards of the sternum, in consequence of the elevated ribs occupying a larger space ; and the capacity of the chest is further increased from above to below, principally by the depression of the diaphragm, and by the elevation of the first ribs and sternum. With regard to the motion of the first rib upwards, considerable difference of opinion exists; and some physiologists consider that this rib is stationary, and forms a fixed point for the action of the intercostal muscles, and necessary elevation of the ribs below. On examination, however, it will be found, that the first rib possesses a more extensive motion than any of the others ; for, while the lower ribs turn only upon their own axis on the spinal column, the first ribs have a distinct elevation throughout their whole length, being raised by the scalenus anticus and medius; and in connection with the sternum, their elevation is also assisted by the action of the sterno cleido mastoideus.

This fact is proved by the enlargement of the upper

opening of the chest during inspiration; and still further by the form of the articulations, and distribution of the ligaments of the first rib, which admit of this particular motion, and differ from the articulations of the other ribs.

Respiration is performed by the action of two sets of muscles—those of inspiration and those of expiration.

The muscles of inspiration, are the intercostales, levatores costarum, diaphragma, sterno cleido mastoidei, scaleni, serrati postici superiores, serrati magni, subclavii, pectorales, latissimi dorsi, ascendentes cervicales, and the accessorii ad sacro lumbales.

The muscles of expiration, are the triangulares sterni, all the abdominal muscles, serrati postici inferiores, longissimi dorsi, sacro lumbales, quadrati lumborum; assisted by the cartilages of the ribs.

But under ordinary circumstances, these muscles of inpiration and expiration are not all called into action; hence they have been divided into the muscles of ordinary, forced, and violent respiration.

Muscles of Inspiration.

Ordinary.—Diaphragma.

Forced.—Intercostales, and levatores costarum.

Violent.—Sterno cleido mastoidei, sealeni, serrati postici superiores, serrati magni, subelavii, pectorales, latissimi dorsi, cervicales ascendentes, and accessorii ad sacro lumbales.

Muscles of Expiration.

Ordinary.—The relaxation of the diaphragm, and the cartilages of ribs.

Forced—Abdominal muscles.

Violent.—Triangulares sterni, serrati postiei inferiores, longissimi dorsi, sacro lumbales, quadrati lumborum.

Practical Remarks.

Superficial wounds of the chest do not differ from superficial wounds of other parts of the body, excepting from its constant motion, which endangers a greater degree of inflammation and liability to the form-

ation of abscess; hence the necessity of confining the motions of the ribs as much as possible, in all cases of severe injury.

When wounds penetrate the chest, there is danger of injuring the lungs, the heart, the large vessels, and even the œsophagus. These will be indicated by the passage of air, and small quantity of blood through the wound, accompanied with emphysema of the surrounding parts, of profuse hæmorrhage, if the heart or large vessels be wounded, or even of the passage of the contents of the œsophagus, when injury extends to that part.

The occurrence of emphysema more frequently follows fracture of the ribs and narrow stabs, than of more extensive wounds; because in the latter cases the air has a free exit, and is not forced into the cellular membrane of the surrounding parts. When an accumulation of air takes place between the pleura costalis and pulmonalis, the lung is not so capable of receiving air in each succeeding inspiration, which produces dyspnœa. It is doubtful, however, from experiments which have been made upon the subject, whether the admission of air necessarily produces a collapse of the lungs. Some authors recommend wounds into the chest to be left open, until such time as the wound of the lung has healed; so that the air may pass through it: and if there be any obstruction to its passage, and the difficulty of breathing increases to any alarming degree, the original wound of the parietes to be enlarged; or even a second opening to be made into the pleura.

When the accumulation of air takes place externally in the cellular membrane, scarifications and friction are the best means of relieving the symptoms produced, and are almost always efficient.

Should the lungs be wounded deeply, as indicated by the flow of blood from the wound, or its escape from coughing, the patient can only be saved by repeated blood-lettings, which must be carried to the utmost extent discretion could warrant.

Should extraneous bodies be lodged in the cavity of the chest, the opportunity should not be lost, if fainting should occur, of attempting their removal, even by enlarging the wound when it is necessary.

Protrusion of a portion of the lung may happen, though it is but of very rare occurrence; there are, however, cases on record in which mortification of the protruded part took place, and extirpation was resorted to with success: in others, the parts remaining healthy have been returned into the cavity of the chest, with an equally favourable result.

Empyema, or collection of pus within the chest, sometimes follows wounds of these parts, and is indicated by symptoms of the formation of matter, as in other parts of the body. If the abscess forms within the substance of the lungs, it is usually discharged through the bronchiæ; but it may open itself into the cavity of the pleura, and

produce such difficulty of breathing, from its pressure on the lungs, as to render the operation of paracentesis thoracis necessary. The presence of matter within the cavity of the pleura, is known by the dull sound on tapping the chest with the fingers, as well as by the necessity which the patient has to lie on the diseased side, which relieves the lungs from the pressure of the matter; such symptoms being corroborated, of course, by the previous history of the patient's symptoms.

When matter forms between the pleura costalis and the intercostal muscles, the pleura becomes considerably thickened, so as to form a barrier to its internal direction, and a fluctuating tumour is therefore felt externally; usually however, unattended with discoloration of the skin. These abscesses should be opened as soon as fluctuation is discovered, to prevent its further extent, and the possibility of its escaping inwards. The openings should be made as much as possible in the most dependent direction, when the action of the lungs during respiration is sufficient to promote the discharge of the matter, in conjunction with the contraction of the cavity of the abscess. If this disease be attended with caries of the ribs, the cure is always difficult and protracted. Abscesses sometimes form behind the sternum in the anterior mediastinum, producing, besides those symptoms common to the formation of matter, pressure of the lungs, attended with difficulty of breathing; and displacement of the heart, with irregularity of the pulse; such cases have been occasionally mistaken for aneurism; but a proper diagnosis may be formed from a careful attention to previous symptoms, and from a minute examination of the tumour itself, under various positions of the body. These abscesses have been relieved, either by being opened between the cartilages of the ribs, or by a portion of the sternum being removed with a trephine. A case of this kind came under Sir Astley Cooper's notice, in which the patient, who was a surgeon, was considered by others, and himself believed to be dying of aneurism of the arch of the aorta; as the tumour had a motion corresponding with the pulsation of the heart: Sir Astley Cooper, upon examination, discovered the nature of the case; and gave instant relief, both to the body and mind of the patient, simply by puncturing the abscess with a lancet.

Remarks upon fractures of the bones of the chest have already been given, when treating on osteology.

LECTURE XVII.

DESCRIPTIVE ANATOMY OF MUSCLES.

Muscles of the Perinæum.

THE next part to be dissected, having finished the muscles which are connected with the ribs, and which perform the function of respiration, are the muscles of the perinæum, which are better displayed before, than after the dissection of the muscles of the lower extremities.

The perinæum is that part of the body which is placed between the anus and the organs of generation; it is of a triangular form; bounded above, or rather in front, in the erect posture of the body, by the scrotum in the male, and by the vulva in the female; by the anus, behind and below; and by the rami of the pubes and ischia, laterally. This space is much larger in the male than in the female; and of the former I shall first treat.

To dissect this part in the male, the subject should be placed and confined in precisely the same position, as for the operation for the stone; a sound should be passed into the bladder, the handle of this instrument being fastened with the penis attached to it at a right angle with the horizontal position of the trunk, and the scrotum being held to one side, the dissection may proceed.

But before the knife is used, the student should place an articulated pelvis in the same position with that of the subject; so that he may learn the precise relative bearing of the bony parts, with respect to each other; by the just knowledge of which, all the operations connected with this part can only be properly understood. Next, he should examine the perinæum of the subject, and he will find the

skin of a darker colour than of other parts of the body, being continuous above (as the subject is now placed) with the skin of the scrotum; below, being much thinner, surrounds the anus; and, laterally, extends on the buttocks and thighs. In the centre, reaching from the anterior part of the anus, a dense and distinct line may be seen, which passes along the perinæum, scrotum, and under surface of the penis; this is termed the raphé, and divides the perinæum into symmetrical halves.

The integuments may next be removed by making an incision along the raphé, from the scrotum to the anus; and by dissecting the skin of each side outwards, and turning the flap towards the thigh, the sphincter ani muscle will be exposed, and the superficial fascia of the perinæum.

The *m. sphincter ani*—surrounds the anus, and is of an elliptical form; it *arises* by tendinous fibres from the extremity of the os coccygis; soon becomes fleshy; its fibres separate, pass around the sides of the extremity of the rectum, and unite at the front part of the bowel, to be *inserted* into the condensed cellular membrane and raphé of the perinæum; uniting with some of the fibres of the transversus perinæi and accelerator urinæ.

In the erect posture of the body, its inferior surface is covered by the skin of the perinæum; its upper with the levator ani, and superficial fascia; while, anteriorly, it unites with the accelerator urinæ, and transversus perinæi muscles.

Use.—To close the anus, and to draw the bulb of the urethra downwards and forwards; it is a muscle of the mixed class.

Above this muscle is found a condensed layer of cellular membrane, termed the fascia superficialis perinæi; and which is connected laterally, to the rami of the ischia and pubes; and, above, continuous with the superficial fascia of the scrotum and abdomen. The exact attachments of this fascia are most important, and should therefore be most accurately understood; as the direction of extravasated urine, and of matter in abscesses of the perinæum, is regulated by it. By minute examination, it will be found along the whole

length of the rami of the pubes and ischia to be so firmly connected with the periosteum of those bones, as to prevent any fluid passing downwards towards the thighs; below the transversus perinæi muscle it dips backwards, to the tuberosities of the ischia, and becomes connected with the deep fascia of the perinæum; so that they are blended with each other: but above, where it passes to the scrotum and abdomen, it is so loosely connected with these parts, that if fluid be injected under the superficial fascia, it invariably makes its escape from the perinæum in those directions.

This fascia may now be removed, by making an incision in the direction of the raphé, and reflecting it outwards precisely in the same manner as described for the removal of the skin; when there will be exposed the accelerator urinæ in the mezian line, the erector penis laterally situated, on either side passing in the long axis of the perinæum, and the transversus perinæi muscles passing from the tuberosities of the ischia to the fore part of the anus, so as to divide the perinæum into an anterior and posterior region; and we shall find, that the anterior space contains the bulb of the urethra with its muscle, the erectors of the penis, and deeper seated the levator ani; while the posterior space contains the lower extremity of the rectum and its muscles.

The *m. accelerator urinæ*—is found in the mezian line of the anterior space between the anus and membranous portion of the urethra, surrounding the bulb. It may be considered as a single muscle divided into symmetrical halves, although generally described as a pair of muscles. It *arises* from the deep fascia of the perinæum, between the bulb of the urethra and the erector penis, posteriorly, being connected with the sphincter ani and transversi perinæi muscles; the muscle then proceeds forwards, covering the corpus spongiosum, and in the middle line is furnished with a raphé, so as to give the appearance of two muscles; laterally it is connected with the crura of the penis: it thus proceeds to the anterior part of the corpus spongiosum, where its fibres diverge (so as to leave an interval in

which is seen the urethra,) to be *inserted* into the corpora cavernosa of the penis.

In the erect posture, the inferior surface of this muscle rests upon the superficial fascia of the perinæum; the upper surface is connected laterally with the crura of the penis, and the deep fascia of the perinæum, and in the middle line receives and supports the bulb of the urethra; anteriorly, it is lost upon the membranous covering of the corpora cavernosa of the penis; posteriorly, it is blended with the fibres of the sphincter ani, and transversus perinæi.

Use.—To compress and elevate the bulb of the urethra, so as to accelerate the ejection of the urine and sema.

The *m. erector penis*—is a thin flat muscle, *arising* tendinous and fleshy from the inner side of the tuberosity of the ischium, in connection with the inferior sacro sciatic ligament; the fibres proceed forwards, inwards, and upwards, converging towards those of the opposite side, adhering to the crus penis, and reaching the corpus cavernosum is *inserted* into the membranous investment of that body.

This muscle is bounded on its outer side, by the rami of the ischia and pubes; on its inner, by the accelerator urinæ, being separated from it by a considerable space of a triangular form, in which is found the artery of the perinæum, and a considerable quantity of fat; its inferior surface is covered by the superficial fascia; and its superior by the crus and corpus cavernosum penis.

Use.—To direct rather than erect the penis, unless it performs the latter office by preventing the return of the blood from the organ by the compression of the veins.

The *m. transversus perinæi*—is composed of a few fleshy fibres, which *arise* from the inner side of the tuberosity of the ischium, above the attachments of the erector penis; the fibres pass inwards and slightly forwards to be *inserted* into a tendinous line, situated between it and the muscle of the opposite side, and being also connected with the sphincter ani, and accelerator urinæ.

There are also in some subjects, a few muscular fibres *arising* from the ramus ischii, which proceed inwards above and deeper seated than the preceding muscle, to be *inserted* into the accelerator urinæ: this is termed the *m. transversus perinæi alter,* is usually wanting, but ought only to be considered as a part of the accelerator muscle.

This muscle is bounded, anteriorly, by the erector penis, and accelerator urinæ; posteriorly, by the sphincter ani; and externally, by the deep branch of the internal pudic artery.

Use.—To support the anus, and to dilate the bulb of the urethra.

The transversus perinæi muscle forms the base of a triangular space, which is bounded, externally, by the erector penis; internally, by the accelerator urinæ, and urethra; and, in front and above, by the corpus cavernosum. Through this space, on the left side of the patient, the knife is directed to the groove of the staff in the operation of lithotomy, as well as the lancet when plunged in opening deep perinæal abscesses.

The accelerator urinæ, and the erector penis, with the transversus perinæi of either side, should now be carefully removed from their attachments, so as to expose the deep perinæal fascia, which should now be examined.

The fascia perinæi profunda—is situated behind the preceding muscles; and by its junction with the triangular ligament of the pubes, separates the pelvis from the perinæum, being furnished however with two openings, through the upper of which the urethra passes, and the rectum through the lower. Tracing this fascia from below upwards, it will be found to begin from the inner side of the tuberosity of the ischium, there being connected with the posterior sacro sciatic ligament, covering the internal pudic artery; it proceeds upwards, attached to the ascending ramus of the ischium, and descending ramus of the pubes as far as the triangular ligament of the pubes, with which it joins on its under surface, passing across to the bones of the opposite

side. This ligament forms, therefore, a deep-seated fascia behind the muscles of the perinæum, in the same manner as the superficial fascia does in front of them. Below, it forms a concave edge, which surrounds the upper surface of the rectum, reaching from the tuberosity of the ischium on one side to the other, at which points it is attached to the superficial fascia; its upper edge is also concave, surrounding the under surface of the membranous part of the urethra, leaving a space between it and the triangular ligament for the passage of that canal. There are yet two portions in connection with this ligament, which claim particular attention; these are given off from the point of junction between the triangular ligament and perinæal fascia, forming the passage for the urethra. The anterior, or perinæal lamina, proceeds along the bulb of the urethra, gives it support, and that peculiar glistening appearance it presents on dissection; it gradually loses itself by becoming more and more attenuated upon the corpora cavernosa. The posterior pelvic lamina passes backwards, surrounds the membranous part of the urethra, and covers the prostate gland, lining at the same time the inner surface of the levator ani; is continued as far as the spinous process of the ischium, where it is lost in the pelvic fascia. Above the membranous part of the urethra, it attaches the bladder to the pubes, and is there named the anterior ligament of the bladder.

The knowledge of the deep fascia of the perinæum is essential from the circumstance, that when the urethra is ruptured on its pelvic side, urine is extravasated into the cellular membrane within the pelvis; and extravasation of even a small quantity in this situation, is highly dangerous, from its proximity to the peritonæum; inflammation of which frequently occurs after operations and accidental ruptures of the urethra, causing, from its insidious progress, the most unexpected fatal terminations. Openings in the urethra on the anterior or perinæal side of this fascia, causes extravasation, attended with abscess, which shews itself in the perinæum, scrotum, and above the pubes. For the reasons

already given, extravasations extend in these directions, and not within the cavity of the pelvis.

The circumstance most frequently rendering operations necessary in this part is, retention of urine from an impervious state of the urethra, through which instruments cannot be passed ; in such cases the urethra is obliged to be opened through the perinæum ; or the bladder punctured above the pubes, or per rectum. The detailed circumstances rendering such operations necessary, and the mode of performing them, more properly belong to a work professedly on surgery. I shall however here remark two cases of considerable peculiarity and practical utility.

In both of these cases insuperable retention of urine existed, attended with abscess in the perinæum; and, from the history of the cases, it was reasonable to suppose rupture of the urethra had occurred. In the first case, after the matter had been evacuated, I opened the urethra, passed a female catheter into the bladder, and drew off the urine ; having done this, I proceeded to pass a male catheter along the natural passage, and to my surprise found that the canal was pervious, and that the retention had been occasioned entirely by the pressure of the matter.

In the second case, the same insurmountable difficulty in the passage of the instrument occurred, and I was obliged to proceed as in the first case as far as the evacuation of the matter; after which the water was drawn off through the natural passage without further difficulty.

It appeared that, in these cases, the collection of matter pressed the urethra out of its natural course, and raising it above the opening in the triangular ligament caused, in conjunction with it, a duplication of the passage, which was insurmountable.

From this history, we learn the propriety, whenever an impervious state of the urethra is concomitant with abscess, of examining the state of the canal after the evacuation of the matter.

When the deep fascia of the perinæum is removed, the whole extent of—

The *m. levator ani*—is exposed. This muscle *arises* fleshy from the posterior part of the symphisis pubis, by thin tendinous fibres from the obturator fascia, beginning at the upper edge of the obturator foramen, reaching backwards along the ilium and ischium, as far as the spinous process of that bone; from these origins the fibres radiate, passing downwards and inwards towards the lower opening of the pelvis to be *inserted* into a tendinous raphé, formed by the union of the two muscles, which extends from the os coccygis to the anterior extremity of the rectum.

The anterior, or pubic portion of this muscle, surrounds the membranous portion of the urethra; and these fibres being somewhat distinct from the rest of the fibres of the levator ani, have been described by Mr. Wilson as a distinct muscle, under the name of the *compressor urethræ;* but they are too intimately connected with the levator ani to warrant their description as a separate muscle.

This muscle is of a funnel-like form, arising from the inner parietes of the pelvis, and descending, its fibres converge towards its fellow of the opposite side, principally filling up the lower opening of the pelvis; it lies between two layers of the deep perinæal fascia, the innermost of which separates this muscle from the rectum, membranous part of the urethra, prostate gland, and vesiculæ seminales; posteriorly it is in contact with the coccygeus muscle. Its anterior termination lies between the sphincter ani and the longitudinal muscular fibres of the rectum, forming some few circular fibres around the verge of the anus, which have been termed the internal sphincter.

Use.—To raise the rectum, and to draw it backwards towards the pelvis, when it has been protruded in the expulsion of the fæces; it also assists in propelling the urine and seminal fluid; and the anterior fibres which surround the membranous part of the urethra, perhaps, upon some occasions, act as a sphincter.

The *m. coccygeus*—is of a triangular form, situated behind the levator ani; it *arises* from the inner side of the spinous process of the ischium, and anterior sacro sciatic ligament, along which it runs, forming a thin fleshy belly; its fibres diverging to be *inserted*, tendinous and fleshy, into the side of the last bone of the sacrum, and the two upper of the os coccygis, immediately anterior to the attachment of the glutæus maximus.

This muscle is placed between the levator ani and gluteus maximus; its posterior surface is covered by the sacro sciatic ligaments; its anterior corresponds to the rectum.

Use.—To draw the os coccygis forwards during the expulsion of the fæces.

The perinæum of the female differs from that of the male, chiefly in its size, which is little more than an inch in length, reaching from the posterior part of the vulva to the anus; and, as in the male subject, the central line forms a raphé. The muscles are nearly similar, both in their origins and insertions; the exceptions are, that the *erector clitoridis*, which answers precisely to the erector penis, is *inserted* into the crura of the clitoris, as the latter is into the crura of the penis.

The *m. constrictor vaginæ*—surrounds the exterior opening of the vagina; it *arises* from the crura of the clitoris, the fibres of one side diverging from the other, so as to surround the orifice of the vagina; at the lower and posterior part of which they again converge to be *inserted* in the centre of the anterior part of the perinæum, in a point common to the sphincter ani and transversi perinæi.

Use.—To contract the orifice of the vagina.

Practical Remarks.

There are comparatively but few surgical remarks connected with this part in the female, in consequence of the large size, and the shortness of the meatus urinarius. Retention of urine is of very rare occurrence, unless produced by pressure in the progress of uterine gestation, or retroversion of the uterus. The perinæum is liable to injury from rupture, when it is not properly protected during difficult parturition; and in these cases the patient is sometimes left in the most deplorable

situation, from a permanent extravasation of urine, and even sometimes passage of the fæces through the part.

The anatomy of these parts will now lead us to the consideration of the more important operations for relief of those diseases to which the urinary and genital organs of the male are liable.

One of the most common of these operations to which a surgeon is called is, the introduction of an instrument for the dilatation of some contracted portion of the urinary canal; the mechanical aid employed may be either the soft and flexible waxen boujie, or a metallic instrument; but, whether the one or the other be employed, the surgeon's object should be to direct it in the natural course of the passage, which, under common circumstances, is readily performed. But should there from disease of the canal itself, or mechanical pressure from either abscess or any other morbid cause, be a difficulty in the passage of the instrument; the surgeon will, with patience and gentleness, prosecute the operation in the following manner.—The patient should be placed in the horizontal posture, with the knees bent, and the thighs separated; the point of the catheter is to be introduced into the urethra, the *handle* of the instrument being parallel with the horizontal position of the body; the *handle* should now be raised, and will be carried, unless there be obstruction in this portion of the urethra, readily to a right angle with the trunk—thereby arriving at the membranous portion of the canal: here very frequently an obstruction occurs, not however from any morbid cause, but from the manner in which the urethra is embraced by the deep fascia of the perinæum; an obstacle usually at once overcome, by drawing the penis forwards; thus straightening the canal, at the same time depressing the *handle* of the instrument; which forms the third step, and completes the operation by conveying the instrument into the bladder.

The wished for end is not always thus easily gained, from a morbid condition of the urethra, produced by permanent or spasmodic stricture; rupture of the urethra, with false passage (frequently the result of violent and hasty surgery); and enlargement of the prostate gland. As it is not however my province, from the nature of this work, to enter minutely into details, I will only, in generalising on this subject, deprecate in the strongest manner the determination too frequently formed of *forcing* an entry into the bladder.

In cases of retention of urine, where immediate relief is necessary, and after bleeding, purging, and warm-bath have been employed in vain, it is then for the surgeon's consideration, depending always upon the nature of the obstruction in the individual case, whether he should rely upon the possibility of a safe introduction of his catheter, or upon the more hazardous operation of opening the bladder.

An enlargement of the third lobe of the prostate seldom renders it necessary to puncture the bladder, although it frequently forms an obstinate obstruction to the introduction of a catheter; but which may be overcome by another step superadded to those recommended in the introduction of an instrument into the bladder under common circumstances. After the instrument has passed between the lateral lobes of the prostate gland, its further entry is resisted by the morbid development of the central third lobe ; hence the necessity of the use of a longer and larger instrument ; the depression of the *handle* of which, to a still further extent than before recommended, tilts the point over the new and obstructing growth.

The more important operation for the removal of urinary calculi from the bladder, will be described with the anatomy of the pelvic viscera ; as a previous knowledge of the relative position of these organs is indispensable to a true understanding of the necessary steps in the performance of this operation.

LECTURE XVIII.

DESCRIPTIVE ANATOMY OF MUSCLES.

Muscles of the Lower Extremity.

The muscles of the lower extremity may be divided into those of the hip-joint, those of the knee, those of the ancle-joint, and those common and proper to the toes.

The same principle exists here as in the joints of other parts of the body,—namely, the muscles moving each joint are inserted into the bones next in connection below. Thus the muscles of the hip-joint are all inserted into the femur; the muscles which move the knee, into the tibia and fibula; the muscles of the ancle, into either the tarsus or metatarsus; and the muscles common and proper to the toes, are inserted into the phalanges. Hence on looking at the insertion of any muscle, the student at once knows the joint and function to which it belongs.

The muscles of the hip-joint are fourteen in number; and although several of them combine in the performance of various actions, still however they may be classed as three flexors, three extensors and abductors, six rotators outwards, one rotator inwards, and one adductor.

These muscles are covered by a strong fascia, which it is necessary first to describe.

The *fascia lata.*—The anterior portion of this fascia has already been spoken of, in connection with the anatomy of femoral hernia; but independent of its origin as described from Poupart's ligament and the os ilium, it also arises, posteriorly, from the os sacrum and coccygis, from the posterior part of the crista of the ilium, from the spinous process

and tuberosity of the ischium, where it is connected with the sacro sciatic ligaments; from these origins it proceeds downwards upon the posterior part of the thigh, giving a covering to the muscles of this region; its edges are firmly attached throughout the whole length of the linea aspera, thus forming the posterior fascial bag: it is then continued to the heads of the tibia and fibula, where it is lost in the fascia of the leg. Anteriorly, the fascia lata arises from the anterior superior spinous process of the ilium, from the whole length of Poupart's ligament, from the pubes, Gimbernat's ligament, and linea ilio pectinea; from these origins it proceeds downwards, gives an anterior covering to the muscles of the thigh, and completes the anterior bag by passing to be attached to the whole length of the linea aspera, in common with the posterior bag, continuing downwards on the fore part of the thigh to the condyles and sides of the patella. Thus the muscles of the anterior region of the thigh, are completely separated from those of the posterior region by the intervention of this fascia; which dips internally, between the triceps adductor femoris, and vastus internus; externally, between the vastus externus and glutæus maximus above, and vastus externus and short head of the biceps below.

Besides these attachments of the fascia, it is right to mention, that it is thicker and stronger on the outer than on the inner part of the thigh; and that in several situations it splits to give a perfect envelopment to some of the muscles; particularly to the gluteus maximus, tensor vaginæ femoris which is inserted into it, and the sartorius.

The crescentic opening on the anterior part of this fascia, and other peculiarities of its anterior origins, have been already given when speaking of the parts connected with hernia.

Between this fascia and the common integuments, there is a dense cellular membrane, which is called the fascia superficialis; it forms a covering to femoral hernia, and has also been before described.

Practical Remarks.

In opening abscesses, attention must be paid to the situation of the matter, whether in the anterior or posterior bag, as they have no communication with each other; as was noticed in reference to the fascial coverings of the arm. In amputation above the knee, a skilful operator will make his first circular incision through the skin and superficial fascia only; for when the fascia lata is cut through at the same time, the retraction of the integument is effected with greater difficulty, in consequence of the much firmer attachment of the fascia to the muscles than to the skin.

We may now proceed to the dissection of the muscles of the hip-joint.

The three flexors are, the psoas, iliacus, and pectineus.

The *m. psoas magnus—arises* tendinous and fleshy from the sides of the bodies of the four superior lumbar, and the last dorsal vertebra, from the fore part of the roots of their transverse processes, and sometimes also from the head of the last rib; from these origins the muscle forms a thick belly, at first slightly contracted, enlarging as it descends, until it reaches the linea ilio pectinea, where it again contracts, becomes tendinous; and leaving the pelvis with the iliacus passes downwards into the thigh, to be *inserted* into the trochanter minor, extending a short distance below it.

Above, its origin is covered by the diaphragm, the psoas minor when it exists, and a small portion of the kidney; the lower portion of this muscle has resting upon it, the external iliac artery and vein; and the tendon, where it passes to be inserted, has the same vessels in front of it, under the name of femoral artery and vein. The inner edge of the muscle covers the bodies of the lumbar vertebræ, transmitting between its fibres a plexus of lumbar nerves; when the tendon gains the thigh, it is placed between the pectineus muscle on its inner, and the tendon of the iliacus on its outer side —these tendons being connected with the capsular ligament of the hip-joint.

Between the tendon of the psoas magnus, the pubes, and the capsular ligament of the hip-joint, a bursa is situated.

Use.—To flex the thigh upon the pelvis, and slightly to rotate it

outwards; it serves to maintain the body in the erect posture, acting as an antagonist to the extensors of the spine. When the inferior extremities are fixed, it will bend the body forwards, or obliquely to one side, as both or one muscle act.

Although the psoas parvus is not a muscle destined to move the hip-joint, yet from its situation, and for the facility of dissection, it is impossible to describe it at a more convenient time.

The *m. psoas parvus.*—This muscle does not always exist: when present it *arises* from the sides of the bodies of the last dorsal and first lumbar vertebra; it forms a fleshy belly which ceases opposite to the fourth lumbar vertebra, terminating in a flat tendon, which becoming broader as it descends, passes to be *inserted* into the linea ilio pectinea, at the point of junction of the ilium with the pubes; it also sends an aponeurotic expansion, which is connected at Poupart's ligament with the fascia lata.

It is situated anteriorly, and to the inner side of the psoas magnus; its origin is covered partly by the diaphragm, and renal vessels, and plexus of nerves, and at its insertion by the external iliac vessels.

Use.—When the pelvis is fixed, to flex the trunk; or bend it obliquely, when one muscle only is in action.

The *m. iliacus internus*—is a flat, triangular, radiated muscle, filling up the venter of the ilium; it *arises* fleshy from the transverse process of the last dorsal vertebra, from the ilio lumbar ligament, from the inner labium of the crista of the ilium, reaching from the sacro iliac symphisis along its two posterior thirds; from the greater part of the venter of the ilium, and also from its anterior and inferior spinous processes; being below this attached to the capsular ligament of the hip-joint.

From these origins its fibres converge, and pass outwards under the crural arch with the psoas magnus; terminating in a tendon firmly united to, and *inserted* in common with the tendons of the psoas magnus, into the lesser trochanter, between the vastus internus and pectinæus.

This muscle covers the iliac fossa, the articulations of the femur, and the upper part of the origin of the rectus; it is covered above the crural arch, within the pelvis, by the cœcum on the right, and the sigmoid flexion of the colon on the left; below the crural arch, it is bounded by the sartorius on its outer side, by the pectinæus and crural vessels and nerves on its inner side. The cellular membrane in the bend of the groin separates it from the crural aponeurosis anteriorly.

Use.—To flex the trunk and pelvis, or to bend the thigh directly forwards.

The *m. pectineus*—is a flattened triangular muscle, *arising* from the pubes, in a space extending from the spine of that bone outwards and backwards, along the linea ilio pectinea; being attached to the fore part of Gimbernat's ligament; from thence it descends, passing in front of the obturator foramen, with an obliquity downwards, backwards, and outwards, to be *inserted* by a flat thin tendon into the linea aspera, immediately below the trochanter minor, and behind the vastus internus.

This muscle is covered by the femoral vessels, and anterior crural nerve, which are however separated from it by an interval which is filled up with cellular membrane; it lies upon the pubes, obturator externus, and origin of the adductor brevis muscle; its inner edge is covered by the adductor longus, and its outer edge is parallel with the psoas magnus; it is inserted immediately below the psoas and iliacus, and above the adductor brevis.

Use.—This muscle flexes the thigh upon the pelvis, slightly assists in the adduction of the limb, and performs in some measure the office of a rotator outwards.—The principal action, however, of the three muscles of the hip-joint just enumerated, are, to flex the thigh upon the pelvis; and are termed therefore the three progressors, being particularly in action during progressive motion.

These muscles are covered on their anterior surfaces by the fascia iliaca, which passes down to form the posterior layer of the sheath of the femoral vessels; being above, at

the diaphragm, connected with the fascia transversalis, and on the outer edge of the iliacus muscle, with the anterior layer of the fascia lumborum.

The progress of the dissection now requires that the glutei muscles, which are the extensors and abductors of the hip, and being exterior to so many other muscles, should next be described.

For this purpose the subject must be placed prone, and the pelvis raised so as to place these muscles in a comparative state of extension. The fibres of the gluteus maximus will be exposed in their course by an incision made from the sacro iliac symphisis to the trochanter major.

The *m. glutæus maximus—arises* from the posterior third of the outer labium of the crista of the ilium, from the posterior sacro iliac ligament, from a tendon common to it, the latissimus dorsi and sacro lumbalis, from the outer side of the sacrum, and side of the sacro coccygeal ligament, from the side of the os coccygis, and from the posterior sacro sciatic ligament; from these different origins the fibres pass obliquely outwards, downwards, and forwards, forming a strong thick fleshy muscle of large bundles of fasciculi, distinctly separated by cellular membrane; passes over the trochanter major, where it is furnished with a bursa mucosa, and over the tuberosity of the ischium; after which its fibres, being firmly attached to the fascia lata, converge to be *inserted* tendinous into the linea aspera, beginning immediately below the trochanter, and extending three inches down that line; the tendon being furnished with one or two small bursæ between it and the femur.

The glutæus maximus is superficial, and forms the greater bulk of the nates; its outer surface is covered by the integuments, and a very thin layer of fascia lata. It covers at its upper part portions of the ilium, sacrum, and os coccygis, posterior half of the glutæus medius, pyriformis, gemini, and obturator internus muscles; lower down it covers the trochanter major on the outer side where it is connected with the tensor vaginæ femoris, the tuberosity of the ischium on

the inner side, covering the origin of those muscles of the knee-joint which arise from that portion of bone, namely, the semimembranosus, semitendinosus, and biceps; and between the trochanter and tuberosity it covers the ischiatic nerve and vessels, the quadratus femoris, and adductor magnus muscle.

Use.—To extend the thigh by carrying it backwards, and slightly to rotate it outwards; the two act forcibly to maintain the equilibrium of the body in its erect and bent positions.

On the raising of the glutæus maximus, which should be left attached by its tendinous insertion, you expose

The *m. glutæus medius*—which *arises* from the outer edge of the anterior and superior spinous process of the ilium, and from the dorsum of that bone between the crista and the semilunar ridge, marking the origin of the glutæus minimus, reaching as far back as the posterior and superior spine; also from a rough ridge, extending between the two anterior spinous processes: from these several origins, the fibres converge, forming a thick triangular muscle, which passes to be *inserted* into the upper and outer part of the great trochanter.

The posterior half of the glutæus medius is covered by the glutæus maximus; the anterior half by the fascia lata, from which some of its fibres are said to arise; it covers the glutæus minimus, and the deep branches of the glutæal artery; its inferior edge is running parallel with the pyriform muscle, crossing it at its point of insertion, where a bursa mucosa is placed.

Use.—Principally to abduct the thigh; its posterior fibres tend to rotate the thigh outwards, and the anterior fibres to rotate the thigh forcibly inwards; while the whole muscle maintains the equilibrium of the body in the erect position.

This muscle should now be raised from its origin to expose

The *m. glutæus minimus*—which *arises* by short aponeuroses from a semilunar line on the dorsum of the ilium, extending from the anterior and inferior spinous process

backwards to the ischiatic notch ; and also from that portion of the dorsum between this ridge and the acetabulum; it forms a thin triangular muscle, its fibres converging towards a tendon arising more from its external than its internal surface, and which is *inserted* into the upper anterior part of the trochanter major ; posteriorly being blended with the tendon of the gluteus medius.

The insertion of this muscle is usually furnished with a bursa mucosa. It is entirely covered by the gluteus medius; it lies upon the lower part of the dorsum of the ilium, the capsular ligament of the hip-joint, and the tendinous origin of the rectus femoris.

Use.—The same as the preceding muscle, except in being more powerful as a rotator of the thigh-bone inwards.

The *m. pyriformis*—is a muscle *arising* from within the pelvis by distinct tendinous and fleshy origins from the second, third, and fourth pieces of the sacrum, just on the outer side of the anterior sacral foramina ; it is also partly connected with the posterior sacro sciatic ligament: from these origins it proceeds outwards, leaves the pelvis by passing through the ischiatic notch, and immediately forms a tendon, which passes to be *inserted* into the upper and anterior part of the fossa situated on the inner side of the trochanter major. The fibres of the fleshy origin of this muscle, are sometimes separated by branches of the lumbar plexus passing to form the sciatic nerve.

The posterior surface of the pyriformis covers the sacrum, and gluteus maximus ; anteriorly, it is covered by the rectum, lumbar nerves, and internal iliac vessels ; it is bounded above, by the gluteus medius; below, by the superior geminus—between which two muscles its tendon is inserted, being however somewhat connected with the tendon of the gluteus by a small bursa mucosa.

Use.—This muscle is a rotator of the thigh outwards, at the same time slightly drawing the femur upwards; and when the thigh has been first flexed, it abducts it.

Immediately below the pyriformis, a small muscle is seen running parallel to it, which is termed

The *m. geminus superior*—which *arises* from the outer edge of the spinous process of the ischium, and from the anterior sacro sciatic ligament, takes a course directly outwards to be *inserted* into the fossa on the inner side of the trochanter major, between the insertions of the pyriformis, which is above it, and the obturator internus, which is below it.

In this posterior view of these muscles, the next which presents itself in the order of dissection is the tendon of the obturator internus; but to expose the fleshy origin of it, the subject must be turned round upon the back, when it will be found arising from the anterior and inferior parietes of the pelvis.

The *m. obturator internus*—*arises* by aponeurotic fibres from that portion of the pubes which forms the inner part of the circumference of the foramen obturatorium; it also arises from the obturator ligament, which fills up that foramen, as well from the ischium between the foramen and the ischiatic notch; from these origins the fleshy fibres converge towards the spinous process of the ischium; at which point they form a tendon, which passes out of the pelvis, lodged in a slight groove covered with cartilage, placed between the spinous process and tuberosity of the ischium, and consequently between the two sacro sciatic ligaments. The tendon may then be seen in the position in which it was first described when the subject was lying prone, passing to be *inserted* between the gemini muscles, with whose tendons it is connected, into the fossa on the inner side of the trochanter major.

Within the pelvis, this muscle is placed between the levator ani muscle, and obturator ligament; and as it leaves the pelvis passing through the lesser sciatic notch, its tendon is furnished with a bursa mucosa placed between it and the bone.

The *m. geminus inferior*—is placed below, but in conjunc-

tion with the tendon of the obturator internus; it *arises* from the back and outer part of the tuberosity of the ischium, and from the posterior sacro ischiatic ligament; its fibres pass outwards, and form a tendon, which may indeed be considered as common to the three last described muscles; and is *inserted* into the digital fossa, on the inner side of the trochanter major.

The gemini, and the tendon of the obturator internus muscles, are covered by the glutæus maximus, sciatic nerve, and vessels; they are placed between the pyriformis above them, and the quadratus femoris and obturator externus, which, in this view, is concealed by that muscle, below them.

Use.—These three muscles act together in rotating the thigh outwards; and by being connected with the capsular ligament of the hip-joint, serve to strengthen the articulation, and to prevent the ligament from being pressed between the bones during motion.

The *m. quadratus femoris*—is situated immediately below the geminus inferior, extending transversely between the ischium and trochanter; it *arises* from the outer side of the tuberosity of the ischium; its fibres are directed outwards to be *inserted* into a rough line passing from the lower and back part of the great trochanter to the trochanter minor; and which is termed, in consequence of its receiving the insertion of this muscle, the *linea quadrata.*

This muscle is covered posteriorly by the glutæus maximus, ischiatic nerve, and vessels; it covers the obturator externus; its origin is anterior to the origins of the semimembranosus, semitendinosus, and biceps; and its insertion partly covers the tendons of the psoas and iliacus, where they are inserted into the trochanter minor; above, it is bounded by the geminus inferior, and below, by the upper free edge of the adductor magnus, internal circumflex, and branches of the obturator artery.

Use.—To rotate the thigh outwards, and to adduct it.

The next muscle to be dissected, according to the classifi-

cation I have adopted as to their function, is the obturator externus muscle, being one of the rotators outwards of the thigh; but in consequence of its deep situation, covered posteriorly by the quadratus femoris, anteriorly by the adductor longus, brevis, and pectinæus muscles, it may be more convenient not to examine the origin of it, until the adductor triceps femoris has been dissected and removed: however, it may be well to expose the posterior view of this muscle at this period of the dissection, by cutting through the quadratus femoris and reflecting it towards its attachments.

The subject is again to be turned upon the back, to dissect the adductor muscle of the hip-joint.

The *m. triceps adductor femoris*—is composed of three distinct origins, which pass from the pelvis to the femur.

The *m. adductor longus*—is the anterior of the three; it *arises* by a short strong tendon from the pubes, in a space between its spinous process and symphisis; it soon becomes fleshy, and passes downwards, backwards, and outwards, to be *inserted* by a narrow tendon into the linea aspera in the middle third of the femur.

The origin of this muscle is placed between the pectineus and gracilis, and anterior to the adductor brevis; its insertion is posterior to the vastus internus, separated from it by the fascia lata, and anterior to the adductor magnus; it has, where attached to the femur, above it, the insertion of the adductor brevis; below it, the adductor magnus: it is covered in front by the fascia lata, sartorius muscle, and femoral vessels.

The *m. adductor brevis*—*arises* tendinous and fleshy from the pubes, between the symphisis and obturator foramen; from thence it descends outwards and backwards to be *inserted* into the linea aspera, between the insertion of the pectineus and the adductor longus, occupying the upper third of the body of the femur.

It is covered anteriorly by the adductor longus, and pectineus; it lies upon the adductor magnus and obturator

externus; internally it is bounded by the gracilis, and externally by the psoas and iliacus; its insertion is on a plane anterior to the pectineus, and adductor magnus.

The *m. adductor magnus*—is by far the largest, and most posterior muscle of the three; it *arises* fleshy from the whole length of the descending ramus of the pubes, and ascending ramus of the ischium; also tendinous from the tuberosity of that bone: from these origins the fibres pass outwards aud downwards, with various degrees of obliquity, those from the pubes most transversely to be *inserted* into the whole length of the linea aspera; and at the junction of the middle with the lower third of the femur, it sends off a rounded tendon to be inserted into the internal condyle.

The adductor magnus arises behind the other two adductors; its insertion is also behind these muscles, but anterior to the glutæus maximus and short head of the biceps, from which it is separated by the attachment of the fascia lata to the linea aspera between them. It is covered anteriorly by the gracilis, long and short adductors, pectinæus, sartorius and femoral vessels; which latter, at the inferior fourth of the thigh, penetrate a foramen composed of fascia, common to this muscle and the vastus internus, to gain the popliteal region. The upper edge of this muscle, as it passes from the tuberosity of the ischium to the femur, runs parallel to and below the quadratus femoris; the three heads of the adductors are perforated by the muscular branches of the profunda artery.

Use.—The triceps adductor femoris brings the one thigh forcibly towards the other, and tends to rotate it outwards; the two shorter heads assist in flexing the femur upon the pelvis, but the adductor magnus opposes them in this action.

The three origins of this muscle, and the pectinæus, being now separated from the pelvis, we expose the attachment of the sixth rotator outwards of the thigh.

The *m. obturator externus*—*arises* from that portion of the pubes and ischium which form the circumference of the obturator foramen, as well as from the obturator ligament:

the fibres converge from these origins, passing obliquely outwards and backwards towards a groove situated between the tuberosity of the ischium and the acetabulum; here they form a tendon, which winds around the neck of the femur, adhering to the capsular ligament, and is ultimately *inserted* into the lower part of the digital fossa, on the inner side of the trochanter major.

Anteriorly the origin of the obturator externus is covered by the triceps, pectinæus, and obturator vessels; posteriorly, it is attached to the obturator foramen, and ligament; its tendon is covered, anteriorly, by the hip-joint; posteriorly, by the quadratus femoris; and is bounded, above, by the geminus inferior muscle.

Use.—To rotate the thigh outwards; and when the glutæi abduct the lower extremity, to support the hip-joint, and to assist in again adducting the limb.

The fourteenth and last muscle of the hip-joint is—

The *m. tensor vaginæ femoris*—which is placed at the upper and outer part of the the thigh. It *arises* by a narrow tendinous origin from the outer part of the superior and anterior spinous process of the ilium; being narrow above, it becomes broader as it descends obliquely backwards, to be *inserted* into the fascia lata, about three inches below the trochanter major.

This muscle is concealed by the fascia lata of the thigh, being completely enclosed between two layers; the origin of the muscle is between the sartorius, which is anterior to it, and the glutæus medius, which is behind it; its insertion is anterior to the insertion of the glutæus maximus.

Use.—To stretch the fascia lata; and, if still in a state of action, to rotate the thigh inwards; it also assists in the abduction of the limb.

I have thus given the muscles belonging to the function of the hip-joint, in order that the student might connect their use and relation to each other; but some difficulty will arise in this progress of dissection, from the insertions of several of these muscles being concealed by some of those which belong to the knee-joint.

Nevertheless I consider the adoption of this plan preferable, in order that the muscles of different joints should not be confounded with each other.

The muscles of the knee-joint are ten in number; six flexors, and four extensors. The flexors are situated principally on the back part of the thigh; the extensors on the fore part: and they are more or less separated from each other by processes of the fascia lata.

Before these muscles can be traced to their insertions into the tibia and fibula, the fascia of the leg must be described.

This fascia is a continuation of the fascia lata of the thigh, commencing from its attachment to the bones of the leg; it is strengthened by fibres from the tendons of the extensors of the knee-joint in front, from the biceps externally, from the flexors and inner hamstring internally, and from the poplitæus posteriorly; it proceeds downwards towards the ancle, adhering firmly to the bones of the leg, and forms an aponeurotic covering, confining all the muscles on the anterior part of the leg; while, posteriorly, it separates them into a superficial and deep layer by a strong portion which dips between them; while external to the posterior muscles, it forms but a comparatively thin investment. At the upper part of the leg, this fascia is strongest, and becomes thinner as it descends, until it reaches the malleoli, where its strength again increases by the addition of some tendinous fibres, which form with it the annular ligament.

The deep posterior portion of this fascia cannot be seen until the extensors of the ancle-joint have been dissected.

The external fascia of the leg must be removed, to proceed with the dissection of the muscles of the knee-joint.

The four extensors of the knee-joint, are the rectus, cruræus, and two vasti.

The *m. rectus femoris*—*arises* by a strong tendon from the anterior and inferior spinous process of the ilium, and also from the dorsum of the bone, just at the edge of the acetabulum, being there connected with the capsular ligament of the hip-joint; from these two tendinous origins it

forms a thick fleshy muscle, which passes vertically downwards to be *inserted* tendinous into the upper part of the patella, in common with the vasti; continuing downwards so as to form in part the ligamentum patellæ.

This is a double penniform muscle; its upper half, anteriorly, is covered with tendon, over which the sartorius glides; while its posterior surface, in the lower half, is also furnished with tendon, which facilitates its motion on the cruræus.

Its anterior surface is covered by the fascia lata, iliacus, and sartorius muscles; its posterior surface, above, covers the capsular ligament of the hip-joint, and the external circumflex vessels; in the rest of its extent it lies upon the cruræus and vasti muscles.

Use.—To extend the leg, and to assist in flexing the thigh upon the pelvis. In the erect posture, it fixes the pelvis and adds strength to the hip-joint.

The *m. cruræus—arises* from the fore and external part of the femur, commencing from a space between the two trochanters; it proceeds downwards, along three fourths of that bone; and on the outer side, extends as far backwards as the linea aspera: it then inclines forwards, becomes tendinous, posteriorly, where it is separated from the bone by a considerable quantity of adipose matter, and a large bursa; its tendon is *inserted* into the upper part of the patella, behind the rectus, in common with that muscle and the two vasti.

The anterior surface of the cruræus is covered by the rectus and two vasti, to which muscles it is firmly connected; superiorly, they are somewhat separated by some large vessels and nerves which pass between them.

Use.—To assist in extending the leg.

The *m. vastus externus*—is the largest of the three muscles which cover the anterior surface of the thigh-bone; it *arises* above, by a broad, tendinous and fleshy origin, from the root and outer surface of the trochanter major, anterior to the tendon of the glutæus maximus; from the whole

length of the outer edge of the linea aspera, reaching as far as the external condyle, and from the flattened outer surface of the femur; from these origins it forms a strong fleshy belly, which is tendinous anteriorly above, and posteriorly below; from which tendons its fibres also arise, and pass obliquely downwards and forwards to be *inserted* into the outer edge of the tendon of the rectus and corresponding part of the patella, sending off an aponeurotic process, which passes over the outer side of the knee-joint to be inserted into the tibia.

It is covered by the fascia lata, and partly by the rectus; it overlaps the outer edge of the cruræus; its origin from the linea aspera is anterior to the insertion of the glutæus maximus, and the origin of the short head of the biceps, being separated from them by a process of fascia lata.

Use.—To extend the knee, and assist in the rotation of the limb outwards.

The *m. vastus internus*—begins to *arise* from the fore part of the os femoris, immediately below the trochanter minor; from the anterior edge of the whole length of the linea aspera, and from the inner surface of the femur; this muscle, like the preceding, is tendinous anteriorly above, and posteriorly below, where its fleshy fibres descend lower than those of the vastus externus, and pass obliquely downwards and forwards, to be *inserted* into the inner edge of the tendon of the rectus and side of the patella; sending off an aponeurosis, which covers the inner side of the knee-joint, and terminates in the fascia of the leg.

At the root of the trochanter minor its origin is anterior to the insertion of the iliacus and psoas, along the linea aspera; it is anterior to the pectinæus, and triceps adductor femoris; it partly overlaps the cruræus, and is covered by the fascia lata, which separates it from the posterior muscles of the thigh; inferiorly, it is crossed by the sartorius.

Use.—To extend the leg, and slightly rotate it inwards.

The flexors of the knee-joint are, the sartorius, gracilis, semitendinosus, semimembranosus, biceps, and poplitæus.

The *m. sartorius*—is the longest muscle in the body, and crosses the thigh from without inwards in a serpentine direction; it *arises* by short aponeurotic fibres from the anterior and superior spinous process of the ilium, soon becomes fleshy, and passes obliquely downwards and inwards along the upper third of the thigh; it is then directed vertically towards the back part of the inner condyle, where it again alters its course by passing forwards and outwards to be *inserted* by a flat tendon into the inner side of the tibia, immediately below its tubercle; this tendon also expands into an aponeurosis, which is connected with the fascia of the leg.

The sartorius, anteriorly, is covered by the fascia lata; it arises between the tensor vaginæ femoris and iliacus; in its passage downwards to its insertion, it successively covers the psoas, iliacus, rectus, cruræus, and vasti muscles; then reaching the triceps adductor femoris, runs for some way parallel with, and between it and the gracilis; in the middle of the thigh it crosses the femoral vessels; and lastly, the internal lateral ligament of the knee-joint. In its upper third its internal edge forms the outer boundary of a triangular space between it and the adductor longus, in which the femoral vessels and nerve are placed. It is this space wherein the femoral artery is usually secured in cases of poplitcal aneurism; and the sartorius muscle is the guide for the incision which exposes its sheath.

Use.—To flex the leg upon the thigh, and direct it across the opposite extremity; if still kept in action, it assists the flexion of the thigh upon the pelvis; it slightly rotates the leg outwards.

The *m. gracilis*—*arises* from the anterior surface of the body of the pubes, from the descending ramus of that bone, and the ascending ramus of the ischium; from these origins it passes vertically downwards on the inner side of the thigh, becoming narrower as it descends; and at about the junction of the middle with the lower third of the thigh, forms a round tendon, which passes behind the internal condyle, and is *inserted* into the inner and upper part of the tibia, below

and behind the insertion of the sartorius; also sending an aponeurotic expansion to the fascia of the leg.

At its origin, it is placed on the inner side of the triceps femoris, between it and the crus penis; its inner surface is covered by the fascia lata, and below by the sartorius; it covers the adductor magnus, semimembranosus, and the internal lateral ligament of the knee-joint; it is inserted between the sartorius, which is above it, and the semitendinosus, which is below it.

Use.—To flex the leg, and also to adduct it.

The four remaining flexors of the knee are situated on the posterior part of the thigh.

The *m. semitendinosus*—*arises* tendinous and fleshy from the tuberosity of the ischium, in common with the long head of the biceps, and fleshy from the inner side of the tendon of the biceps; from these origins the fibres pass obliquely downwards and inwards, forming a fleshy muscle, which terminates in a round tendon about four inches above the knee; this tendon passes behind the internal condyle placed between the inner origin of the gastrocnemius, and tendon of the semimembranosus; is *inserted* into the inner side of the tibia, below the insertion of the gracilis muscle, to which it is connected by an aponeurotic expansion, as well as to the fascia of the leg.

The origin of the semitendinosus is covered by the glutæus maximus; it lies between the biceps and gracilis; posteriorly it is covered by the fascia lata, anteriorly it crosses the upper part of the adductor magnus.

This muscle is usually intersected about its middle by a transverse tendinous line; from which circumstance it has been probably named; for, in fact, it is not so tendinous a muscle as the semimembranosus.

Use.—To flex the leg, and to turn it slightly inwards.

The *m. semimembranosus.*—Its origin is concealed by the common origin of the preceding muscle, and of the long head of the biceps; it *arises* by a flat tendon from the upper

and fore part of the tuberosity of the ischium; the tendon becomes broader as it descends, before the fleshy fibres commence, then forms a thick belly, which passes with very slight obliquity downwards, and terminates in another flat tendon, which is directed vertically to be *inserted* into the upper, inner, and back of the head of the tibia; the outer edge of this tendon sends off an aponeurotic expansion, which passing anterior to the inner head of the gastrocnemius, assists in forming the posterior ligament of Winslow, which is affixed to the external condyle of the femur.

This muscle lies between the biceps on its outer side, and the semitendinosus on its inner; it is bounded, anteriorly, by the adductor magnus, and posteriorly, it is covered by the fascia lata; it forms the inner boundary of the popliteal space.

Use.—To flex the leg; and it also, from its connection with the semilunar cartilages, through the medium of the posterior ligament of Winslow, performs the important office of fixing them in their relative situation during the motions of the knee-joint.

The *m. biceps flexor cruris*—*arises* by a long and a short head: the long head, by a tendon from the upper and outer part of the tuberosity of the ischium, in common with the semitendinosus; it proceeds downwards and outwards, diverging from the semitendinosus, forms a thick fleshy belly which, below the middle of the thigh, unites with the short head: the short head arises by aponeurotic fibres from the linea aspera, immediately below the insertion of the glutæus maximus to within two inches of the outer condyle; here the fibres of the two heads unite at an acute angle, and terminate in a strong tendon, which passes behind the external condyle; and then, being directed forwards, and outwards, is *inserted* into the upper, outer, and back part of the head of the fibula, sending off an aponeurosis to be connected with the posterior ligament of the knee-joint.

The origin of the long head is covered by the glutæus maximus, is connected with the semitendinosus, and covers the origin of the semimembranosus; in passing downwards

to be connected with the short head, its anterior surface covers the semimembranosus, vastus externus, and adductor magnus; its posterior surface is covered by the fascia lata. As it diverges from the semimembranosus, it forms the outer boundary of a triangular space, within which is placed the great sciatic nerve. The tendon of this muscle, inferiorly, forms the outer boundary of the popliteal space, or outer hamstring.

Use.—To flex the leg, and, when flexed, to rotate the leg outwards; its long head also extends the thigh upon the pelvis.

The *m. poplitæus*—is next in order to be dissected; but some difficulty arises in exposing it, from its lying under the origins of the external head of the gastrocnemius, and plantaris muscles. It *arises* by a thick and strong tendon from a sulcus situated on the back part of the external condyle of the femur, beneath the attachment of the external lateral ligament of the knee-joint; this tendon passes obliquely downwards and inwards, being attached to the posterior ligament of Winslow, and the external semilunar cartilage; the muscle then becomes broad and fleshy, to be *inserted* into a triangular space occupying the superior fifth of the posterior surface of the tibia,

The posterior surface of this muscle is covered by the gastrocnemius, plantaris, popliteal vessels, and posterior tibial nerve; its anterior surface is in contact with the posterior ligament of Winslow, external semilunar cartilage, tibialis posticus muscle, and the triangular space on the upper part of the tibia.

Use.—To flex the knee, and confine the external semilunar cartilage in its situation, and to rotate the tibia and foot inwards.

We next proceed to the dissection of the muscles of the ancle-joint, which are six in number; namely, the gastrocnemius, plantaris, solæus, tibialis posticus, peroneus longus and brevis tibialis anticus, and the peroneus tertius: which last is usually described as a portion of the extensor longus digitorum.

From the intimate connection of these muscles with those of the toes, and from their situation being in common, the same difficulty occurs which we had to contend with, in the dissection of the muscles of the fore arm.

Instead, therefore, of following their dissection strictly according to their function, we shall describe them in the following order, which is consistent with their natural situation; namely, those which are *posterior* to the tibia and fibula, those which are *anterior*, and those situated on the *outer* side.

The posterior muscles are six in number, which are divided into a superficial and deep-seated layer; the superficial layer consists of three muscles belonging to the ancle-joint; the deep-seated layer is also composed of three muscles, of which, one belongs to the ancle-joint, one common to the toes, and one proper to the great toe.

The anterior muscles are three in number; one of which belongs to the ancle-joint, one common to the toes, and one proper to the great toe; in this region also is found the peroneus tertius, which, when described separately, is also a muscle of the ancle-joint.

The external muscles are two in number; both of them belonging to the ancle-joint.

The superficial layer of the posterior muscles, consist of the gastrocnemius, plantaris, and solæus; which, being inserted by a common tendon, are, by some anatomists, termed the triceps extensor pedis.

The *m. gastrocnemius—arises* by two distinct tendinous origins; one from each condyle of the femur, the inner one being larger, and descending lower than the outer; they converge as they pass downwards, and soon unite, where they form a common aponeurosis, from which the fleshy fibres of the muscle arise, and form a strong fleshy belly, which terminates a little below the middle of the tibia in a broad flat tendon, which is common to it and the solæus, and is termed the tendo Achillis; *inserted* into the back part of the tuberosity of the os calcis; sliding over the

upper half, where it is furnished with a bursa mucosa, and being firmly implanted into the lower half.

The external origin of this muscle is covered by the poplitæus; the internal origin, by the semimembranosus; the triangular intervening space lodges the poplitæal vessels, the posterior tibial nerve, and the plantaris muscle; the anterior surface of each head is furnished with a small bursa between them and the condyles of the femur. The belly of the muscle is superficial, forms a large portion of the calf of the leg, and its anterior surface, which is most aponeurotic, rests on the solæus muscle.

Use.—To extend the ancle-joint, by raising the heel and throwing the weight of the body upon the toes; its two heads strengthen the articulation of the knee-joint, by preventing the condyles of the femur slipping backwards off the tibia.

The *m. plantaris*—is the third muscle that is attached to the external condyle of the femur; from the upper part of which it *arises,* also from the posterior ligament of Winslow, and from the tendinous origin of the outer head of the gastrocnemius; from these origins it soon forms a short fleshy belly of about three inches in length, which descends obliquely inwards, to terminate in a long, thin tendon, just below the union of the two heads of the gastrocnemius; this tendon passes downwards between the gastrocnemius and soleus, and at the lower third of the leg passes out from between them, parallel and adhering to the inner side of the tendo Achillis, with which it is *inserted* into the tuberosity of the os calcis.

This muscle is covered by the gastrocnemius and fascia of the leg; anteriorly, it lies upon the external condyle of the femur, the posterior ligament of Winslow, the poplitæal vessels, and the poplitæus and soleus muscles.

Use.—It assists in extending the ancle-joint; it is not, however, to be found in all subjects.

The *m. soleus,* or *gastrocnemius internus*—*arises* by aponeurotic fibres from the posterior part of the head of the fibula, from the outer angle of that bone, and from two thirds

of its length downwards, being in this situation placed immediately behind the peroneus longus. The second head arises from the oblique line, on the posterior surface of the tibia, which is seen immediately below the insertion of the popliteus muscle, and from the middle third of the inner edge of that bone; from these origins the fleshy fibres pass downwards, converging as they descend, and uniting, form a large belly, which extends nearly to the ancle-joint, is *inserted* by uniting with the tendon of the gastrocnemius to form the tendo Achillis.

The posterior surface of the soleus is covered by the gastrocnemius, plantaris, and fascia of the leg; its anterior surface is also covered by a fascia, which separates the three superficial from the deep muscles of this region.

Between the two origins of this muscle, are placed the posterior tibial artery and nerve.

Use.—The same as the two preceding muscles, forming together the tendon Achillis, which is broader above than below, and is separated to a considerable distance from the tibia and fibula, in consequence of the projection backwards of the tuberosity of the calcis.

These muscles should now be cut through, and reflected towards their attachments, when the fascia which separates them from the deep layer will be exposed.

The knowledge of the precise situation of this fascia is of importance, as it forms the readiest guide in the operation for securing the posterior tibial, and fibular arteries.

The deep-seated layer of muscles in the posterior region of the leg, and which are anterior to the above-named fascia, are the tibialis posticus, flexor longus digitorum, and flexor longus pollicis.

The *m. tibialis posticus*—*arises* by a broad fleshy origin, disposed in two distinct bundles of fibres; one from the outer and back part of the fibula: the other, which is the larger of the two, from the oblique line on the back part of the tibia, the anterior tibial vessels passing between the bifurcation; it also arises fleshy from the whole length of the interosseous ligament, occupying the greater part of its

breadth above, and the centre part below, and from the angles of the tibia and fibula, to which the interosseous ligament is attached; from these several attachments the fibres descend obliquely downwards, and terminate in a strong round tendon which passes behind the malleolus internus, through a groove formed for it in the tibia, proceeding obliquely forwards and inwards in the sole of the foot, to be *inserted* principally into the upper and inner part of the os naviculare, sending tendinous fibres, which are at tached to the internal, and external cuneiform bones, to the cuboid, to the os calcis, as well as to the second and third metacarpal bones.

The tendon of this muscle, as it passes beneath the astragalus, is furnished with a bursa mucosa, and sometimes with a sesamoid bone.

The origin of this muscle has some few fibres passing through the upper interosseal opening, and is therefore described by some anatomists as arising from the anterior part of the tibia and fibula. The rest of its anterior surface covers portions of the tibia, fibula, interosseous ligament, and some of the tarsal ligaments. The posterior surface of the tibialis posticus is covered by the fascia separating the superficial, from the deep seated muscles, and by the flexor longus digitorum, and flexor pollicis; the two latter of which, although they partly cover this muscle, I have not deemed it necessary to separate them in my classification of the muscles belonging to the functions of the ancle-joint. The tendon of this muscle, when it has reached the sole of the foot, passes under, and supports a strong ligament, which extends from the os calcis to the os naviculare, underneath the astragalus; and is principally concerned in maintaining, or receiving the weight of the body, when jumping from an eminence.

Use.—To extend the ancle-joint, and to direct the inner edge of the foot upwards.

The *m. flexor longus communis digitorum pedis*—*arises* from the posterior flattened surface of the tibia, commencing

immediately below the origin of the soleus muscle, and extending three fourths down the bone, from the interosseous ligament, and from the anterior surface of the deep fascia of the leg; the fleshy fibres from these origins descend obliquely inwards, being thickest in their middle part, and terminate in a tendon which commences at the internal and posterior part of the muscle. The tendon then passes behind the malleous internus in the same groove with, but below, the tibialis posticus, and passing on the inner sinuosity of the os calcis, reaches the sole of the foot, in the middle of which it divides into four tendons: these diverge, proceed forwards to the bases of the first phalanges, where they enter tendinous the thecæ, and passing through the split tendons of the flexor brevis digitorum at the extremities of the first phalanges, are *inserted* into the extreme phalanges of the four lesser toes.

The anterior surface of this muscle lies upon the tibia, and interosseous ligament; above, to the inner side of the tibialis posticus, which it partly covers; and below, on the inner side of the flexor longus pollicis; it is covered behind by the posterior tibial artery, and deep fascia of the leg.

Use.—To flex the third upon the second phalanx; but if still in action, to bend the other phalanges of the toes, and the toes themselves upon the metatarsus, and ultimately to assist in the extension of the foot.

The *m. flexor longus pollicis pedis*—*arises* fleshy from a flat surface on the posterior part of the fibula, commencing immediately below the attachments of the soleus, and reaching to within an inch of the inferior extremity of the bone; its fibres pass obliquely downwards and inwards, and terminate in a tendon which takes its course behind the inner malleolus, through a groove which is formed first in the tibia, and then continued in the astragalus, where it is posterior to the tendon of the last described muscle; reaches the sole of the foot where it passes above the tendon of the flexor digitorum, and is connected with it by a slip of tendon; it then proceeds between the two origins of the flexor brevis pollicis, between the two sesamoid bones; and penetrating

the fibrous theca, is ultimately *inserted* into the under and posterior surface of the last phalanx of the great toe.

The posterior surface of this muscle is covered by the deep fascia of the leg; the anterior surface lies upon the fibula and tibialis posticus; it lies between the peroneus longus on its outer side, and the tibialis anticus on its inner: its tendon is furnished with synovial membranes behind the inner malleolus, and on the great toe; in the space between the two, its tendon is enveloped by the two heads of the flexor brevis pollicis.

Use.—To bend the second upon the first phalanx, and the toe upon the metacarpal bone; it also extends the foot, and increases its longitudinal arch.

We next proceed to the muscles situated between the tibia and fibula in front, which consist of the tibialis anticus, extensor longus digitorum, and extensor longus pollicis muscles; which receive a covering from the fascia of the leg.

The *m. tibialis anticus*—*arises* fleshy from the outer and fore part of the tibia, immediately below its head, and also from the head of the fibula; in the intermediate space, between the two, its fibres are connected with the tibialis posticus, through the interosseous opening. Its origin extends two thirds down the anterior angle, or spine of the tibia, and inner half of the interosseous ligament, as well as from the posterior surface of the fascia of the leg; its fibres descend obliquely outwards, and terminate in a strong flat tendon, which passes from the outer to the anterior surface of the tibia, runs underneath the annular ligament, and gains the dorsum of the foot; here the tendon becomes broader, passes on the inner side of the tendons of the extensor longus digitorum, to be *inserted* into the upper and inner part of the os cuneiforme internum, and root of the metatarsal bone supporting the great toe.

This muscle is superficially situated; at its origin it is placed on the outer side of the tibia, but lower down becomes anterior to it; it has before it the fascia of the leg, behind

it the tibia, head of the fibula, and interosseous ligament; it has on its outer side, above, the extensor digitorum, and below, the extensor longus pollicis,—a space being left between it and these muscles, in which the anterior tibial vessels and nerves pass. Between the tendon of the tibialis anticus and internal cuneiform bone, a small bursa is situated.

Use.—To flex the ancle-joint, and direct the foot inwards.

The *m. extensor longus digitorum pedis—arises* tendinous and fleshy from the outer surface of the head of the tibia, from the inner side of the head of the fibula, and from about three fourths of its anterior angle ; in part also from the interosseous ligament, and fascia of the leg. Its fibres pass with more or less obliquity inwards, and in the lower third of the leg terminate in a tendon, which commences in the substance of the muscle ; this tendon, before it passes under the annular ligament, splits into three ; and as they gain the dorsum of the foot, the inner tendon bifurcates : the four tendons then diverge, and pass to be *inserted* into all the phalanges of the four lesser toes, covering their dorsal surface as an expanded aponeurosis.

There is a slip of muscle arising from the fibula in common with the extensor longus digitorum, which is by some anatomists described as a separate muscle, under the name of

The *m. peroneus tertius* :—which *arises* generally inseparably with the extensor digitorum communis, from the lower third of the fore part of the fibula and interosseous ligament; from thence it descends with the last described muscle under the annular ligament ; inclosed in the same groove, and gaining the dorsum of the foot, diverges from it to be *inserted* into the base of the metatarsal bone supporting the little toe.

This muscle (or the two, if considered separately) is superficial, covered by the fascia of the leg. At the upper part of the leg, it is placed between the tibialis anticus, and peroneus longus, being firmly connected with them by

intermuscular ligament; at the lower part it is placed between the extensor longus pollicis, and peroneus brevis; its posterior surface is in contact with the fibula, and interosseous ligament.

Use.—To extend the phalanges of the lesser toes; but that portion of the muscle which is termed the peroneus tertius, being inserted into the metatarsus, is a flexor of the ancle-joint; in which function the common extensor of the toes can assist.

The *m. extensor proprius pollicis pedis*—*arises* tendinous and fleshy from the fore part of the two inferior thirds of the fibula, between its anterior and internal angles, within an inch of the ancle-joint; also from the lower part of the interosseous ligament, and some few fibres from the edge of the inferior extremity of the tibia; from these origins, the fibres pass obliquely forwards and downwards, terminating in a tendon, which passes under the annular ligament, runs along the inner side of the foot, and passes to be *inserted* by separate tendons into the two phalanges of the great toe.

This muscle is situated between the tibialis anticus and extensor digitorum communis, and is concealed by them at its origin and middle portion; its tendon then becomes superficial, being covered only by the fascia of the leg. The anterior tibial vessels and nerve lie between this muscle and the tibialis anticus, above the annular ligament; but below, between it and the inner tendon of the extensor digitorum communis.

Use.—To extend the phalanges of the great toe, and to assist in the flexion of the ancle-joint.

The muscles situated on the outer side of the leg, are the peroneus longus and brevis.

The *m. peroneus longus*—*arises* tendinous and fleshy from the outer and fore part of the head of the fibula, and outer side of the head of the tibia; from the external angle of the fibula, two thirds down its length, from the anterior surface of that bone, from the posterior surface of the fascia of the leg, and from the intermuscular tendon, which is anteriorly, com-

mon to this muscle and the extensor longus digitorum, posteriorly, in common to it and the flexor digitorum communis. From these origins the fibres descend with slight obliquity outwards, and at the lower part of the leg terminate in a tendon, which passes through a groove on the inner side of the malleolus externus; then runs forward on the outer side of the os calcis; and reaching the os cuboides, continues through a deep groove in it which directs it inwards, above the muscles in the sole of the foot, to reach its *insertion* into the outer side of the base of the metatarsal bone of the great toe, and the os cuneiforme internum.

It is better to leave the dissection of the insertion of this muscle, until the muscles situated on the sole of the foot have been examined.

This muscle is superficially placed on the outer side of the fibula, being bounded anteriorly by the extensor longus digitorum, and posteriorly by the soleus and flexor longus pollicis; its tendinous insertion is covered by the muscles of the sole of the foot.

Use.—To extend the ancle-joint, and to direct the outer edge of the foot upwards; in which action it is opposed by the tibialis posticus.

The *m. peroneus brevis—arises* by short aponeuroses from the outer and posterior surface of the lower half of the fibula, and from the intermuscular tendons which connect it anteriorly with the extensor longus digitorum, and posteriorly with the flexor longus pollicis; its fibres descend a little obliquely outwards, and at the lower part of the leg form a tendon, which passes behind the malleolus externus with the peroneus longus, then through a groove on the outer side of the calcis, above the tendon of the preceding muscle; it reaches the base of the metatarsal bone, supporting the little toe, into which it is *inserted.*

The outer surface of this muscle is covered by the peroneus longus; it proceeds downwards, between the extensor longus digitorum, which is before it, and the flexor longus pollicis, behind it; at the malleolus externus, the tendon of this muscle is below that of the peroneus longus, but when

it gains the os calcis, the tendon of the peroneus brevis is above and anterior to it.

Use.—To extend the ancle-joint as the preceding muscle.

The tendons of the preceding muscles, as they pass through the grooves behind the malleoli, are tied down by strong tendinous sheaths, lubricated with synovia; the annular ligament, in a like manner, and for a similar purpose, proceeds from one malleolus across to the other, in front of the inferior extremities of the tibia and fibula; being connected to the projections on the surface of the bones.

All the muscles proper to the toes, and some of those common to them, are attached entirely to the bones of the foot, and are by most anatomists classified as the proper muscles of the foot; whereas those of the ancle-joint, which move the foot, are, properly speaking, to be considered as belonging to that division of the lower extremity.

Before these muscles can be dissected, the skin and fascia plantaris must be removed. Of the skin, it may be observed, that it is here thicker than in any other part of the body, in consequence of the constant pressure to which it is exposed; underneath it there is always found a considerable quantity of fat, which furnishes a soft cushion, and prevents the ill effects which would otherwise arise from the concussion and bruising to which the soft parts underneath are liable.

On removing the skin, (which is a task of some difficulty, from the firm manner in which it adheres to the subjacent aponeurosis, by fibres of short and dense cellular membrane),

The *fascia plantaris*—is exposed; it *arises* from the anterior part of the under surface of the tuberosity of the os calcis, and appears as if it were a continuation of the tendo Achillis, commencing by a thick narrow strip, which proceeds forwards along the under surface of the foot, becoming broader and thinner as it approaches the toes, and terminates, being attached by distinct portions to the anterior extremities of the metatarsal bones; each portion

splitting at its insertion to allow of the passage of the flexor tendons of the toes.

Besides the division of this fascia, in the anterior part of the sole of the foot at its insertion into the metatarsus, it also separates itself, in the middle of the plantar region, into three portions: the centre one, which is the thickest, covers the flexor muscles common to the toes; while the lateral more attenuated portions, cover the muscles forming the ball of the great and little toe.

This fascia being removed, the muscles situated above it are to be dissected; the description of which may be much facilitated by arranging them in four layers.

The first layer is composed of the flexor brevis digitorum pedis, in the middle; the abductor pollicis pedis, on the inner; and the abductor minimi digiti pedis, on the outer side.

The *m. flexor brevis digitorum pedis perforatus* — is a muscle common to the toes; it *arises* from the inferior surface, and rather to the inner side of the tuberosity of the calcis, from the upper surface of the fascia plantaris, and the intermuscular tendons, separating this from the abductor pollicis on the inner side, and the abductor minimi digiti on the outer; from these origins, the muscle passes forwards to the middle of the foot, where it divides, sending off four slender tendons, which diverge as they pass to the second phalanges of the four lesser toes, where they split to allow of the transmission of the tendons of the flexor longus digitorum; and are then *inserted* into the anterior extremities of the second phalanges by tendinous expansion.

The under surface of this muscle rests upon the fascia plantaris; the upper surface is covered by the tendons of the flexor longus digitorum, musculus accessorius, and lumbricales; its inner edge is bounded by the abductor pollicis, with which it is connected posteriorly; while, anteriorly, it is separated from it by the tendon of the flexor longus pollicis; its outer edge is bounded by the abductor minimi digiti. The short flexor tendon from this muscle to the little toe, is not unfrequently wanting.

Use.—To flex the second phalanges of the four toes, and to strengthen the arch of the foot, in conjunction with the long flexor of the toes and plantar fascia.

The *m. abductor pollicis pedis.*—This muscle is proper to the great toe, and forms the inner boundary of the inner region of the foot; it *arises* tendinous and fleshy from the inner side of the under surface of the tuberosity of the os calcis, from a ligament which extends from the calcis along the os naviculare to the internal cuneiform bone, and from the fascia plantaris; the fleshy fibres from these origins pass forward parallel to the metatarsal bone supporting the great toe, and are *inserted* tendinous into the inner sesamoid bone, and root of the first phalanx.

The under surface of this muscle rests upon the inner portion of the plantar fascia; its upper surface is partly covered by the flexor brevis pollicis, and the tarsal bones.

Use.—To abduct the great toe.

The *m. abductor minimi digiti pedis*—is proper to the little toe; it *arises* tendinous and fleshy from the outer side and under surface of the calcis, from the fascia plantaris, and from the outer surface of a ligament reaching from the os calcis to the base of the metatarsal bone supporting the little toe; its fibres pass forwards to be *inserted* tendinous into the anterior extremity of the metatarsal bone, and outer side of the base of the first phalanx of the little toe.

This muscle is the most external of this region; its under surface rests upon the outer portion of the fascia plantaris; its outer edge is merely covered by skin; its inner surface is in contact with the bones of the tarsus.

Use.—To abduct, and assist in flexing the little toe.

The second layer of muscles of the sole of the foot consist of the musculus accessorius, and lumbricales, and the tendons of the flexor longus digitorum, and flexor longus pollicis; which tendons have already been described when speaking of those muscles situated in the deep-seated region of the leg.

The *m. accessorius ad flexores digitorum pedis.*—This muscle *arises* fleshy from the sinuosity on the inner surface of the os calcis, and tendinous from the under part of the bone below the sinuosity; its fleshy fibres pass forwards, assuming a flattened square form; after which it converges, and terminates by being *inserted* into the outer part of the tendon of the flexor longus digitorum, just before that tendon divides.

This muscle arises from bone, and is inserted into tendon; its upper surface is covered by the os calcis, tarsal ligaments, and the origin of the abductor minimi digiti; its inferior surface covers the adductor pollicis, flexor brevis digitorum, abductor minimi digiti, and plantar vessels and nerves.

Use.—To assist the flexor longus digitorum in its action.

The *m. lumbricales pedis*—*arises* by four aponeurotic and fleshy origins from the tendons of the flexor longus digitorum, immediately after their division, and pass forward parallel to the inner edge of the long flexor tendons, to be *inserted* into the inner and under surface of the first phalanx of the four lesser toes, and into the tendinous expansion from the tendon of the common extensors, on their dorsal surface.

The lumbricales rest upon the flexor brevis digitorum; their upper surfaces are covered by the transversus pedis, and adductor pollicis.

Use.—To flex the first phalanx of the four lesser toes, and to adduct them, but to extend the second and third phalanges.

These muscles should be cut through, and reflected towards their attachments, to expose the third layer, which consists of the flexor pollicis brevis, adductor pollicis, transversus pedis, and flexor minimi digiti.

The *m. flexor brevis pollicis*—*arises* by a strong tendon from the lower and anterior part of the os calcis, also from the cuboid and under surface of the external cuboid bone. It soon forms a fleshy belly, which is directed forwards and

obliquely inwards, becomes then connected with the adductor pollicis, and passes to be *inserted* by two tendons into the sesamoid bones, and root of the first phalanx of the great toe. Its inferior surface rests upon the tendon of the flexor longus, and adductor pollicis; its upper surface has above, the tendon of the peroneus longus, transversus pedis, and metatarsal bone of the great toe.

Use.—To flex the first phalanx of the great toe upon the metatarsus.

The *m. adductor pollicis*—*arises* tendinous and fleshy from the under and inner surface of the cuboid bone, and from the ligament which connects this bone with the os calcis; it also arises from the bases of the second, third, and fourth metatarsal bones; forms a triangular fleshy belly, the fibres of which converge towards the inner side of the foot, to be *inserted* by a double tendon into the outer sesamoid bone, and base of the first phalanx of the great toe.

The inferior surface covers the tendons of the flexor longus digitorum, lumbricales, and part of the accessorius; its upper surface is in contact with the bones from which it arises; its inner edge corresponds to the flexor brevis pollicis and insertion of the peroneus longus.

Use.—To adduct and assist in flexing the great toe.

The *m. transversus pedis*—*arises* tendinous and fleshy from the under surface and anterior extremity of the metatarsal bone of the little toe; passes inwards, crossing beneath the heads of all the metatarsal bones; and is *inserted* into the outer sesamoid bone, and into the root of the metatarsal bone of the great toe.

The under surface of this long strip of muscle covers the long flexor tendons, lumbricales, and digital branches of the arteries and nerves; the upper surface corresponds to the plantar, interossei, and metatarsal bones; at its insertion, its tendon is connected with the adductor pollicis.

Use.—To maintain the transverse arch of the foot, by drawing the anterior extremities of the metatarsal bones nearer to each other.

The *m. flexor brevis minimi digiti pedis*—*arises* tendinous

and fleshy from the under surface of the os cuboides, from the tendinous sheath which lines the sulcus, in which the tendon of the peroneus longus passes, and from the base of the metatarsal bone of the little toe; from these origins, it forms a fleshy belly, which passes forwards to be *inserted* by tendinous fibres into the lower and outer edge of the base of the first phalanx of the little toe.

The inferior surface rests upon the abductor minimi digiti; its upper surface is covered by the metatarsal bone of the little toe, and the outer plantar interosseous muscle.

Use.—To flex the first phalanx of the little toe.

These muscles being removed, the muscles of the fourth layer are exposed, consisting of the interossei, and the insertion of the tendon of the peroneus longus.

The *m. interossei pedis*—are disposed in a similar manner to those of the hand, being extensors to the toes, and are arranged—four upon the dorsum, and three upon the plantar region of the foot; the three latter of which we have now to describe.

The *m. interossei plantaris*, or *inferiores*—are three in number, and are situated in the spaces between the metatarsal bones.

The first of these, beginning on the inner side, is

The *m. adductor medii, vel tertii digiti—arises* from the inner side of the metatarsal bone of the middle, and from the outer side of the root of the metatarsal bone of the second toe; it then forms a fleshy belly, which fills up the space between the two bones, and is *inserted* into the inner side of the base of the first phalanx of the third or middle toe.

The anterior tibial artery passes through the fibres of this muscle to gain the plantar region of the foot.

Use.—To adduct the third or middle toe.

The *m. adductor quarti digiti—arises* from the inner side of the metatarsal bone of the fourth toe, and also from the root of the third, and passes forwards to be *inserted* into the inner side of the base of the first phalanx of the fourth toe.

The use of this muscle is implied by its name.

The *m. adductor minimi digiti—arises* from the inner side of the metatarsal bone of the little toe, and base of the fourth; and passes to be *inserted* into the inner side of the root of the first phalanx of the fifth toe.

In a like manner to the two preceding, this muscle adducts the toe to which it is inserted.

The tendon of the peroneus longus, which can only be traced to its insertion in this stage of the dissection, has been already described.

We next proceed, in the order of dissection, to the muscles situated on the dorsum of the foot; these are, the interossei externi, and the flexor brevis digitorum.

The *m. interossei externi, vel superiores*—are four in number, are larger than the internal, arise by two heads, and are sometimes called the interossei bicipites.

The *m. adductor digiti secundi—arises* from the inner side of the metatarsal bone of the second, and from the outer side of the metatarsal bone of the great toe—the two origins being separated to admit the passage of the anterior tibial artery; the belly of this muscle passes forward to be *inserted* into the inner side of the root of the first phalanx of the second toe.

Use.—To draw the second towards the great toe.

The *m. abductor digiti secundi—arises* chiefly from the outer side of the metatarsal bone of the second toe, and inner side of the third toe; and passes to be *inserted* into the outer side of the first phalanx of the second toe.

Use.—To draw the second from the great toe.

The *m. abductor digiti medii—arises* chiefly from the outer side of the metatarsal bone of the middle or third toe, and outer side of the fourth; and is *inserted* into the outer side of the base of the first phalanx of the middle or third toe.

Use.—To draw the third toe outwards from the second.

The *m. abductor digiti quarti—arises* from the outer side of the fourth, and inner of the fifth metatarsal bone; and is

inserted into the outer side of the root of the first phalanx of the fourth toe.

Use.—To separate the fourth from the three inner toes.

These muscles, collectively, strengthen the arch of the foot in a transverse direction, by drawing the metatarsal bones closer together; and although, separately, they serve to abduct and adduct the toes, yet, collectively, they assist in their extension.

The *m. extensor brevis digitorum—arises* tendinous and fleshy from the upper and anterior surface of the os calcis, from the astragalus, annular ligament, and os cuboides; from these origins, its fibres form a flat fleshy belly, which separates at its anterior part, and terminates in four slender tendons to be *inserted* into the four inner toes; the innermost tendon, which is the strongest, into the first phalanx of the great toe; while the tendons in common with the extensor longus digitorum, unite to form the aponeurotic expansion which covers the dorsal surface of the three middle toes.

The fleshy fibres of this muscle lie under the tendons of the extensor longus digitorum, and peroneus tertius, but are not concealed by them; the inferior surface lies on the tarsus, metatarsus, interossei superiores, and the phalanges. The flat and slender tendons of this muscle, although they lie above the superior interossei, do not so cover them as to prevent their dissection in the order in which they have been described.

LECTURE XIX.

DESCRIPTIVE ANATOMY OF MUSCLES.

Muscles of the Lower Extremities.

The combined actions of the muscles of the lower extremities, being highly important as the principal agents of locomotion, I shall now proceed to mention several particulars respecting them.

The lower extremities present a remarkable difference from the upper, in being destined to support the great weight of the body, at the same time they have to perform their several motions. The perfection of this combined function, in the structure of the joints of the lower extremities, and which so admirably contributes to the erect position in man; is a principal feature, which renders him superior to all other animals.

The erect posture is maintained by the muscles of the head being inserted into the bones of the spine; the muscles of the spine, receiving their fixed point from the bones of the pelvis; the muscles of the pelvis, from the femora and upper part of the bones of the leg; the muscles of the thigh, from the leg and foot; and the muscles of the leg, from the foot: thus the erect position of the body is the result of the united action of the muscles of these several regions.

Standing in the erect posture on both legs, the centre of gravity will fall in an imaginary perpendicular line between the two; but if the pressure be not equal on both legs, the centre of gravity will fall to that side on which the pressure is greatest, and a degree of obliquity is given to the position of the body. It is necessary to remember, that this change of the centre of gravity constantly occurs in every new

position of the erect posture; particularly in walking and running, when the centre of gravity is alternately transferred from the foot which leaves, to that foot which meets the ground.

The manner in which the pelvis is attached to the thigh-bones, is admirably contrived to facilitate those rapid changes. The pelvis, with the weight of the whole trunk which rests upon it, is immediately supported by the ilio femoral articulations, which are placed nearer to the pubes than to the sacrum; by which conformation, the length of the lever is favourable to those muscles which are attached to the pelvis for the support of the spinal column; while, at the same time, the oblique direction of the neck of the femur, and the manner in which the head is received in the acetabulum, is calculated to support the vertical pressure of the pelvis, and to prevent the tendency of separation of the ilia from the wedge-like articulation of the sacrum. And further, the equilibrium of the pelvis is maintained by a large mass of muscles, which have their attachments to the pelvis, and the femora, both anteriorly and posteriorly.

After these preliminary remarks, we may proceed to mention the motions of the hip-joint; which, like all other enarthrodial articulations, extend in almost every direction, but not to the same extent as those joints which have less weight to support.

The direction of these motions has been classed into those of flexion, as when the thigh is directed forwards upon the pelvis; extension, when carried backwards; abduction, when the thighs are separated; adduction, when approximated; rotation, when the knee is turned outwards or inwards; and circumduction, which is the quick succession of all these motions.

Flexion of the hip-joint, is performed principally by the psoas magnus, iliacus, and pectineus, which, being the first muscles of the lower extremity put in action in progression, are termed the progressors; but flexion is further assisted by other muscles of the hip-joint; namely, the adductor

femoris, tensor vaginæ femoris, obturator externus; and perhaps some few of the anterior fibres of the glutæi, as well as the gracilis and sartorius, two muscles of the knee-joint: all these muscles, excepting the first three, have other direct functions to perform.

Extension of the hip-joint, is effected principally by the three glutæi muscles, aided however by the obturator internus, gemini, quadratus femoris, and adductor magnus, all muscles of the hip-joint; and by the semitendinosus, semimembranosus, and long head of the biceps, which are muscles of the knee-joint.

Abduction of the hip-joint, is performed by the three glutæi, tensor vaginæ femoris, pyriformis, gemini, and obturator internus of the hip, and sartorius of the knee-joint; the three glutæi are to be considered as the principal muscles in abduction.

Adduction of the hip-joint, is produced by the adductor triceps femoris, the quadratus femoris, obturator externus, pectineus, psoas magnus, and iliacus of the hip; semitendinosus, semimembranosus, long head of the biceps, and gracilis, of the knee-joint.

Rotation outwards, by the pyriformis, gemini, obturatores, and quadratus femoris; assisted by the iliacus, psoas magnus, glutæus magnus, medius, and triceps adductor femoris; all of the hip-joint.

Rotation inwards, by the tensor vaginæ femoris, anterior fibres of the glutæus medius and minimus; assisted by the sartorius, gracilis, and semitendinosus of the knee-joint.

All these muscles successively in action, produce circumduction of the hip-joint, assisted by motions of the trunk; and when the thigh-bones are fixed, corresponding motions are produced of the pelvis.

In taking a retrospective view of the motions of the hip, and comparing the functions of this joint with those of the shoulder, we may observe a considerable difference, in the pelvis not being in the same manner capable of accommodating itself to the motions of the femora, as the scapulæ are

to the humeri; hence we should be inclined to believe, that luxation would be much more liable to occur in the hip than in the shoulder, from the greater weight it has to sustain, and the more frequent occurrence of violent exertion. The manner, however, in which the heads of the femora are surrounded by the acetabula, and the angle at which (by the obliquity of the neck) they are connected with the shaft of the bone, tends materially to lessen the frequency of dislocation.

The student, to comprehend the great variety of action in the muscles of the hip-joint during its motions, should not detach them until he has examined with careful attention the following combinations; as in the reciprocal contraction of the flexors and abductors, adductors and extensors, extensors and adductors, then adductors and flexors; which succession of combination, produces circumduction of the limb.

As in the upper extremity the motions of the joints are more limited as they descend, so in the lower extremities, the motions of the knee are less extensive and varied than in the joint above.

The motions of the knee, are flexion and extension, for which different sets of muscles are provided; but independent of flexion and extension, the exertion of these muscles is constantly called forth, in conjunction with those of the hip, to maintain the erect position of the body, by fixing the knee-joint, and confining the condyles of the femur in a steady position upon the head of the tibia; for this purpose, muscles surround the joint in every direction.

The muscles of the knee-joint, are flexors and extensors.

The *flexors* are the gracilis, sartorius, semimembranosus, semitendinosus, biceps, and poplitæus, assisted by the gastrocnemius, and plantaris, muscles of the ancle-joint; while, through the medium of the fascia lata, the glutæus maximus and tensor vaginæ femoris may be said to cooperate.

The *extensors* are the rectus, cruræus, and two vasti, assisted by the tensor vaginæ femoris and glutæus maximus;

the two latter muscles being thus capable of performing either flexion or extension, when the limb is placed in certain positions by the other muscles.

The ancle-joint is capable of flexion and extension, and a slight inflexion outwards and inwards. These latter motions only occur in just reference to the ancle-joint, when the foot is extended, in which position the smaller portion of the articular surface of the astragalus is admitted between the malleoli, and allows of this motion. When the bones of the leg rest on the astragalus at a right angle, or during flexion of the foot, then the larger part of the astragalus is fixed between the malleoli, and the rotatory motion communicated to the foot depends upon the motions of the knee and hip; and wholly to the latter, when the knee is extended.

The *flexors* of the ancle-joint, are the tibialis anticus, and peroneus tertius, as proper to the joint; assisted, however, by the extensor longus digitorum, and extensor pollicis.

The *extensors* are the gastrocnemius, soleus, plantaris, tibialis posticus, peroneus longus and brevis; assisted by the flexor longus digitorum, and flexor longus pollicis.

Inflexion inwards — tibialis posticus, extensor pollicis, flexor longus pollicis, flexor longus digitorum.

Inflexion outwards—peroneus longus, brevis, and tertius; assisted by the extensor longus digitorum.

Motions of the bones of the tarsus and metatarsus are extremely limited, being chiefly confined to the elasticity of their cartilaginous surfaces, and can scarcely be said to depend upon the contraction of muscles, although tendons are so inserted into and interwoven on their surfaces, that their chief action on the bones of the foot depend on the preservation of the strong arches which support the weight of the body; at the same time giving to the foot its great elasticity.

The motions of the toes are much more limited than of the fingers, which no doubt depend, in a great measure, upon their disuse, as well as the manner in which the foot

is clothed. The toes have, similar to the fingers, their common and proper muscles.

The *common flexors* to the toes, are the lumbricales, which are inserted into the first phalanx of the four lesser toes; the flexor brevis digitorum, into the second; and the flexor longus, into the third, or extreme phalanx: these muscles assist also in the extension of the ancle-joint.

The *common extensors,* are the extensor longus, and brevis digitorum communis, which form a common aponeurotic expansion over the dorsal surface of the toes; assisted by the interossei. The two former muscles contribute also to the flexion of the ancle-joint.

Abduction and *adduction* of the three middle toes, are performed by the interossei.

The great toe has all its motions performed by muscles proper to it; namely, its two flexors, an extensor, an abductor, and an adductor muscle.

The little toe has two proper muscles, a flexor brevis, and an abductor.

The os calcis forming the principal fixed point of the bones of the foot, and several of the muscles of the toes taking their origin from it, they contribute in a great measure to maintain the longitudinal arch of the foot; while at the same time their flexion and abduction of the great and little toes, contribute to the elasticity of the foot, and its adaptation to the various surfaces it is brought in contact with in progression.

It is to be observed, also, that the motions of the different joints of the lower extremity are much combined with each other, and in their greatest exertions unite their forces; thus at the time the respective muscles are fixing the hip and knee for the support of the weight of the body, the muscles of the leg are acting for the same purpose upon the foot and ancle.

This combination of action tends materially to lessen the force of pressure and concussion, which would otherwise be liable to produce the frequent rupture of tendon and muscle;

and it may be remarked, that when these accidents do occur, it is under circumstances where the muscles were not prepared to meet the force. At the same time, this combination of force in several muscles allows of a change of action, one set relieving the other, or acting with increased or lessened force alternately, during long-continued exertion ; this is exemplified by the natural habit of resting alternately on one leg or the other when standing in the erect posture.

Having noticed the particular action of muscles individually, I shall now proceed to make some few observations on the muscular motions of the body in general.

The effects of muscular contraction upon the skeleton, are, to determine the attitudes and motions of the body, the movements of the skin, and the organs of the senses ; to regulate the voice ; and, lastly, to contribute more or less to the performance of the vegetative functions, as the circulation of the blood and its various consequences.

We shall, however, now more particularly dwell upon the various phenomena connected with locomotion, which are so essential to the animal economy that we find, even in the lower animals, the configuration of their bodies is in a great measure directed by it ; as may be observed in the various forms of animals of different species.

In the erect posture, as we have already mentioned, the whole of the muscles of the spine and joints of the lower extremity are called into action, so that by the continued cooperation of so many muscles at the same time, we find there is a great expenditure of muscular power, and energy, to produce what apparently is a passive position ; for this reason it is that persons who are much debilitated by sickness, or age, cannot long remain in the standing attitude, and even with difficulty maintain the body in a half erect position.

When standing firmly, the foot is pressed upon the ground by the flexores digitorum communes, by the flexores pollicis, the peroneus longus, tibialis posticus, and the muscles of the sole of the foot ; by which action the pressure will be greatest at the heel and the toes : and owing to the arch

thus strongly maintained in the foot, we are enabled to incline the body either forwards or backwards, so as materially to lessen the fatigue of standing. When carrying heavy burdens, or in consequence of some other great exertion of the body, the longitudinal arch of the foot is diminished, and flattened, and at the same time the foot directed inwards, it presents a larger surface in contact with the ground, which principally enables the individual to stand with greater security.

Standing on tiptoes is effected by the strong extensors of the ancle-joint raising the heel from the ground, while the flexors on the sole of the foot are pressing the toes downwards; the extensors of the toes and flexors of the ancle-joint are in action at the same time to bring the tibia forwards within the centre of gravity.

Walking is less fatiguing than standing, in consequence of the frequent change which takes place in the exertion of different muscles, during which they are alternately in a state of rest and action. Walking is effected, first, by throwing the weight of the body upon one lower extremity, which sets the other at liberty; then the flexors of the hip-joint, by flexing the thigh upon the pelvis, raise the foot from the ground; next the four extensors of the knee-joint advance the leg, while the extensors of the ancle-joint point the advanced foot: the muscles of the opposite firmly fixed limb, having their purchase on the ground, bend the trunk forwards in an oblique direction, so as to throw the weight towards the extended limb, which now receives it, carries it to the ground, where its principal force is met upon the heel, from whence it is transmitted to the rest of the foot; and the body is further advanced by the propelling action of the other foot on leaving the ground, and which, in its turn, goes through the same motions. In the transmission of the weight of the body from the heel to the toes, the foot forms a parabolic curve, which, together with the arches of the foot, materially diminishes the concussion which would otherwise occur.

A remarkable difference occurs in the gait of different people in the act of walking, and in some instances sufficiently demonstrable to form a national distinction; this depends upon different causes, and is more especially to be observed between the inhabitants of mountains, and sandy districts; in the former, the knees are bent, with the body directed forwards; while in the latter, the foot is placed flat upon the ground, for the purpose of affording a larger surface of resistance than could be presented by the heel.

It is obvious, in walking in a straight line, that the motions described by each lower extremity, must be equal; without which, the body will turn from that side in which the motion is greater. In walking up hill, the increased fatigue is owing to the exertion which is required in the greater flexion of the limb which is carried forward and upwards; while the limb behind has not only to move upon the pelvis, but to raise the whole weight of the body, in order to transmit its weight to the elevated and advanced limb.

Running differs from walking in the quickness with which the weight of the body is transmitted from one limb to the other; during which, a period occurs when both feet are off the ground, the body being thrown forwards and upwards by the hinder foot springing upwards before the advanced one reaches the ground; hence running approaches to a continued succession of leaps from one leg.

In *jumping*, the articulations of the lower extremities are considerably bent, and then being suddenly and powerfully extended, the body is pushed, as it were, from the ground; while at the same time, the arms are raised and directed forwards, to give the muscles attached to the upper extremities and trunk a power of drawing the body forwards: this assistance from the upper extremities, is principally required when jumping a distance; for when leaping a height, the body is maintained in an upright direction.

Swimming.—It is doubtful whether or not this power is natural to man; but, perhaps, the circumstance of his specific gravity being less than that of sea water, would lead

to the belief that it was intended as a means of self-preservation. Progressive motion through the medium of the water is performed by throwing the body prone upon its surface, so as to produce the greatest extent of resistance; at the same time keeping the head above the water in order to be able to breathe freely; and then, by sudden and alternate flexions and extensions of the limbs in such a direction as to drive the water backwards, the body is propelled forwards, and, by expert swimmers, with considerable facility and quickness. Although the exertion is great, yet, by a judicious economy of the muscular power, and by gentle respiration, this action may be for a length of time maintained; and a distance of three or four miles passed through this resisting medium.

Practical Remarks.

Connected with the lower extremity; this part, as in others where it is necessary to describe extent of surface, should, for the facility of description, be divided into different regions.

The region of the hip, is bounded above by the pelvis, and below by an horizontal line drawn around the upper part of the thigh, upon a level with the perineum. The superior part of this region, posteriorly, is called the buttock, and comprehends the projection formed by the large glutæi muscles; anteriorly, this region is comprehended between an imaginary line drawn from the anterior and superior spinous process of the ilium to the pubes, above; and the line forming the inferior boundary of this region just mentioned, below; laterally and externally, this region is bounded between the spinous process of the ilium above, and the trochanter major below.

The pupil should observe in the healthy subject the symmetrical form of this region, and remark particularly the exact correspondence of the two sides; any deviation from which, is a general indication of disease or accident.

Beginning in the posterior part of this region—the fulness of either buttock may be increased or diminished from its natural form; the former will occur in abscesses, and during the acute stage of diseases of the hip-joint; the latter, in dislocations, and from the wasting of the muscles in various diseases.

The anterior part of this region is of considerable importance, being the seat of hernia, aneurism, abscess, and glandular tumours; each of which disease is accompanied by alteration in the natural form of the part, and are treated of when speaking of the particular organs con-

nected with the disease. One disease of particular surgical importance connected with the muscles of the hip-joint, may now with propriety be mentioned. Between the tendinous insertion of the psoas and iliacus, and the trochanter minor, the bursa mucosa there situated will occasionally secrete an inordinate quantity of synovia, which projects forwards into the thigh, presenting a tumour, which may be mistaken for abscess or femoral hernia; in such cases a just diagnosis can only be formed by strict attention to the previous symptoms, and history of the case. Considerable surgical importance is also attached to a familiar knowledge of the form of the external surface of this region, where the situation of the trochanter major, its distance from the anterior and superior spinous process of the ilium, and its capability of rotation outwards or inwards, severally indicate the nature of dislocations and diseases of the hip-joint.

The perineal surface of the anterior portion of this region, is the seat of extravasation of urine, when the urethra has given way between the two fasciæ of the perinæum.

The surgical operations connected with the arteries of this part of the body, will be mentioned when treating of the blood-vessels generally.

The femoral region comprehends the whole of the thigh, between the line before mentioned and the knee. With respect to the skin, it is found softer and thinner on the inner than on the outer and back part of the thigh. Beneath the skin, and between it and the fascia upon the upper and anterior part of the femoral region, is situated several small absorbent glands, which are the frequent seats of inflammation and abscess, requiring the evacuation of their contents; but even in this simple operation, the situation of these abscesses renders it of importance, as they may be confounded with hernia;—a circumstance I have twice known to occur, and with fatal consequences. The number of nerves and veins which pervade this region of the lower extremity, between the skin and fascia, render superficial wounds of this part important, from the consequent degree of pain and hæmorrhage which follows. The fascia lata of the thigh, from its little tendency to ulcerate, forms a strong barrier to the escape of matter, and consequently produces a corresponding constitutional irritation; to obviate which, early openings should be made, unless connected with the lumbar region, when much caution is necessary. The evacuation of the matter in relation to the two bags formed by the fascia lata on the posterior and anterior part of the thigh, requires the same precaution as was noticed when speaking of abscess under the fascia of the arm. In the circular amputation of the thigh, the first incision should be made through the skin only, in order to allow the skin to be retracted readily on the surface of the fascia lata. I may also, in speaking of the

circular amputation, mention, that the artery will be differently situated according to the part of the limb cut through: for instance, if on a level with the aponeurotic arch of the adductor magnus, the artery will be found on the inner side of the stump; if below this point, it is placed posteriorly; and if above it, anteriorly and internally.

The bursa mucosa situated under the common tendon to the extensors of the knee, forms the boundary, below which, it is not proper to amputate the thigh. Wounds in this part, which open into the synovial sac, are tedious to heal; and dangerous, should a high degree of inflammation follow, and extend to the knee-joint. Hence, in these accidents, the necessity of placing a splint behind the knee, so as to preclude the possibility of motion.

The lower and posterior third of the femoral region is termed the popliteal space, in which is situated the popliteal vessels, and posterior tibial nerve, as well as a considerable quantity of cellular and adipose membranes, with absorbent glands. In this region, the adipose membrane is sometimes the seat of a fatty tumour, termed steatoma; when from their size it becomes necessary to remove such tumours, the depth of their situation, and their connection with the important vessels of the part, renders this operation one of considerable difficulty.

In the leg, the fascia ties down the muscles so firmly, that when the subjacent parts are injured and swollen, gangrene will occasionally follow, from its great pressure and unyielding nature: to relieve this, early and free openings should be made.

In the region of the foot, the most remarkable surgical points to be attended to, are the various projections formed by the several processes of the bones of the ancle, tarsus, and metatarsus; a correct knowledge of which is necessary, as they form the guide in the amputations which are performed upon this part of the body; as, for instance, in Chopart's operation, and other partial amputations.

The great degree of tensity in the skin of the foot renders it necessary to preserve a large proportion of integument in partial amputations, so as to leave a sufficient covering to the projecting bones; and for the same reasons, a larger flap is required on the inner than on the outer side of the foot.

The great thickness of the skin on the sole of the foot, and its strong connection by dense aponeurotic fibres to the plantar fascia, offers considerable resistance to the swelling of this part from any morbid cause; hence the formation of matter in this part produces excessive pain and constitutional irritation, which is to be relieved by early openings. The skin on the dorsum of the foot, is thin, and affords but little protection to the subjacent parts; hence wounds are more liable to occasion injury to the blood-vessels and tendons here situated; and the tense state of the skin, forms a considerable obstacle to the process of cicatrization.

CLASSIFICATION OF MUSCLES,

ACCORDING TO THE FOREGOING DESCRIPTION.

Muscles of the Abdomen.

Obliquus abdominis externus.
Obliquus abdominis internus.
Transversus abdominus.
Rectus abdominis.
Pyramidalis.
The cremaster muscle—a continuation of some of the fibres of the internal oblique and transversalis.

Muscles of the Exterior of the Cranium and Face.

Orbicularis palpebræ.

Corrugator supercilii - -	Moderators to the orbiculares palpebrarum.
Occipito frontalis - - -	
Levator palpebræ superioris	

Orbicularis oris.

Compressor naris - - -	Moderators to the orbicularis oris.
Levator labii superioris alæque nasi	
Depressor labii superioris alæque nasi	
Levator anguli oris - - -	
Zygomaticus major - - -	
Zygomaticus minor - - -	
Buccinator - - - -	
Levator labii inferioris - -	
Depressor labii inferioris - -	
Depressor anguli oris - -	

Muscles superficially situated on the anterior part of the Neck.

Platysma myoides.
Sterno cleido mastoideus.

Muscles which fix the Os Hyoides.

Sterno hyoideus.
Sterno thyroideus.
Thyro hyoideus.
Omo hyoideus.
Stylo hyoideus.

Muscles which depress the Lower Jaw.

Digastricus.
Mylo hyoideus.
Genio hyoideus.
Genio hyo glossus.

Muscles of Mastication.

Temporalis.
Masseter.
Pterygoideus internus.
Pterygoideus externus.

Muscles of the Tongue.

Genio hyo glossus.
Lingualis.
Hyo glossus.
Stylo glossus.

Muscles of the Fauces and soft Palate.

Constrictor isthmi faucium Palato pharyngeus - - Azygos uvulæ - - -	Forming the soft palate.
Circumflexus palati - - Levator palati mollis -	Moving the soft palate.

Muscles of the Pharynx.

Constrictor pharyngis inferior.
Constrictor pharyngis medius.
Constrictor pharyngis superior.
Stylo pharyngeus.

MUSCLES OF THE UPPER EXTREMITY.

Muscles which attach the Scapula to the Trunk.

Trapezius.
Rhomboideus major.
Rhomboideus minor.
Levator scapulæ.
Omo hyoideus.
Pectoralis minor.
Subclavius.
Serratus magnus.

Muscles of the Shoulder-Joint.

Pectoralis major.
Latissimus dorsi.
Deltoides.
Supra spinatus.
Infra spinatus.
Teres minor.
Subscapularis.
Teres major.
Coraco brachialis.

Muscles of the Elbow-Joint.

Biceps cubiti.
Brachialis internus.
Triceps extensor cubiti.
Anconeus.

Muscles between the Radius and Ulna, anteriorly.

Superficial layer:—

Pronator radii teres.
Flexor carpi radialis.
Palmaris longus.
Flexor digitorum sublimis vel perforatus.
Flexor carpi ulnaris.

Deep seated layer :—

Flexor digitorum profundus vel perforans.
Flexor tertii internodii vel longus pollicis manus.
Pronator quadratus.

Muscles between the Radius and Ulna, posteriorly.

Superficial layer :—

Supinator radii longus.
Extensor carpi radialis longior.
Extensor carpi radialis brevior.
Extensor digitorum communis.
Extensor carpi ulnaris.
Anconeus.

Deep layer :—

Supinator radii brevis.
Extensor primi internodii pollicis, or extensor ossis metacarpi.
Extensor secundi internodii pollicis.
Extensor tertii internodii pollicis.
Extensor indicis.

Muscles of the Palm of the Hand.

Palmaris brevis.
Lumbricales.

Abductor pollicis - - - Flexor primi internodii, vel apponeus pollicis Flexor secundi internodii, vel brevis pollicis Adductor pollicis - - -	Proper to the thumb.

Abductor indicis—proper to the fore finger.

Abductor minimi digiti - Flexor brevis minimi digiti Adductor minimi digiti -	Proper to the little finger.

Interossei.

Muscles of the Back.

For the first and second layers, *vide* p. 150.

Third layer:—
Serratus posticus superior.
Serratus posticus inferior.

Fourth layer:—
Sacro lumbalis.
Longissimus dorsi.
Spinalis dorsi.
Splenius.

Fifth layer:—
Cervicalis ascendens.
Transversalis colli.
Trachelo mastoideus.
Complexus.

Sixth layer:—
Rectus capitis posticus major.
Rectus capitis posticus minor.
Obliquus capitis superior.
Obliquus capitis inferior.
Semispinalis colli.
Semispinalis dorsi.

Seventh layer:—
Multifidi spinæ.
Interspinales cervicis, dorsi, et lumborum.

Muscles deeply-seated on the anterior surface of the Neck.

Longus colli.
Rectus capitis anticus major.
Rectus capitis anticus minor.

Muscle deeply-seated on the anterior surface of the Lumbar Vertebræ.

Psoas parvus.

Muscles situated deeply on the lateral aspects of the Spine.

Rectus capitis lateralis.
Scalenus anticus.

Scalenus medius.
Scalenus posticus.
Intertransversales cervici, dorsi, et lumborum.

Muscles attached to the Thorax, and directly employed in Respiration.

Intercostales externi.
Intercostales interni.
Triangularis sterni.
Diaphragma.
Quadratus lumborum.

Muscles of the Perinæum.

Sphincter ani.
Accelerator urinæ.
Erector penis.
Transversus perinæi.
Levator ani.
Coccygeus.
Erector clitoridis.
Constrictor vaginæ.

MUSCLES OF THE LOWER EXTREMITY.

Muscles of the Hip-Joint.

Psoas magnus.
Iliacus internus.
Pectineus.
Glutæus maximus.
Glutæus medius.
Glutæus minimus.
Pyriformis.
Geminus superior.
Obturator internus.
Geminus inferior.
Quadratus femoris.
Triceps adductor femoris.
Obturator externus.
Tensor vaginæ femoris.

Muscles of the Knee-Joint.

Rectus femoris.
Cruræus.
Vastus externus.
Vastus internus.
Sartorius.
Gracilis.
Semitendinosus.
Semimembranosus.
Biceps flexor cruris.
Popliteus.

Muscles posterior to the Tibia and Fibula.

Superficial layer:—

Gastrocnemius.
Plantaris.
Soleus.

Deep seated layer:—

Tibialis posticus.
Flexor longus communis digitorum pedis.
Flexor longus pollicis pedis.

Muscles anterior to the Tibia and Fibula.

Tibialis anticus.
Extensor longus digitorum pedis.
Peroneus tertius.
Extensor proprius pollicis pedis.

Muscles situated on the outer side of the Leg.

Peroneus longus.
Peroneus brevis.

Muscles of the Foot.

First layer:—

Flexor brevis digitorum pedis perforatus.

Abductor pollicis pedis.
Abductor minimi digiti pedis.

Second layer:—

Accessorius ad flexores digitorum pedis.
Lumbricales pedis.
Extensor longus digitorum pedis.
Extensor longus pollicis pedis.

Third layer:—

Flexor brevis pollicis pedis.
Adductor pollicis pedis.
Transversus pedis.
Flexor brevis minimi digiti pedis.

Fourth layer:—

Interossei plantaris interni vel inferiores.
Tendon of the tibialis posticus.

Muscles situated on the Dorsum of the Foot.

Interossei externi vel superiores.
Extensor brevis digitorum pedis.

TABLE OF THE MUSCLES,

ARRANGED ACCORDING TO THEIR ATTACHMENTS TO THE BONES.

Muscles arising from the Os Frontis.

Temporales.
Corrugatores supercilii.
Orbiculares palpebrarum.

Muscles inserted into the Os Frontis.

Occipito frontalis.

Muscles arising from the Ossa Parietalia.

Temporales.

Muscles arising from the Os Occipitis.

Occipito frontales.
Trapezii.
Constrictor pharyngis superior.

Muscles inserted into the Os Occipitis.

Sterno cleido mastoidei.
Splenii.
Complexi.
Recti capitis postici majores.
Recti capitis postici minores.
Recti capitis laterales.
Recti capitis antici majores.
Recti capitis antici minores.
Obliqui superiores.
Constrictor pharyngis medius.

Muscles arising from the Ossa Temporum.

Occipito frontales.
Masseteres.
Temporales.
Dygastrici.
Stylo glossi.
Stylo hyoidei.
Stylo pharyngei.
Levatores palati.
Tensores tympani.
Levatores tympani.
Stapedei.
Retrahentes aurem.
Anteriores auris.

Muscles inserted into the Ossa Temporum.

Sterno cleido mastoidei.
Splenii capitis.
Trachelo mastoidei.

Muscles arising from the Os Sphenoides.

Levatores palpebrarum superiorum.
Levatores occulorum.
Depressores occulorum.
Adductores occulorum.
Abductores occulorum.
Obliqui superiores occulorum.
Temporales.
Pterygoidii externi.
Pterygoidii interni.
Buccinatores.
Constrictor pharyngis superior.
Tensores palati.
Externi mallei.
Tensores tympani.

Muscles inserted into the Ossa Nasi.

Compressores narium.
Occipito frontales.

Muscles arising from the Ossa Malarum.

Zygomatici majores.
Zygomatici minores.
Masseteres.
Orbiculares palpebrarum.

Muscles arising from the Ossa Maxillaria Superiora.

Masseteres.
Constrictor pharyngis superior.
Pterygoidei externi.
Buccinatores.
Levatores angulorum oris.
Levatores labii superiores alarumque nasi.
Depressores labii superiores alarumque nasi.
Orbiculares palbebrarum.
Obliqui occulorum inferiores.
Compressores narium.

Muscles arising from the Ossa Palati.

Pterygoidei externi.
Pterygoidei interni.
Buccinatores.
Constrictor pharyngis superior.
Azygos uvulæ.

Muscles inserted into the Ossa Palati.

Circumflexores palati.

Muscles arising from the Os Maxillare Inferius.

Depressores labii inferioris.
Depressores angulorum oris.
Levatores labii inferioris.

Buccinatores.
Mylo hyoideі.
Genio hyoidei.
Genio hyo glossi.
Constrictor pharyngis superior.

Muscles inserted into the Os Maxillare Inferius.

Temporales.
Masseteres.
Pterygoidei interni.
Pterygoidei externi.
Digastrici.
Platysma myoides.

Muscles arising from the Os Hyoides.

Digastrici.
Hyo glossi.
Constrictor pharyngis medius.

Muscles inserted into the Os Hyoides.

Mylo hyoidei.
Genio hyoidei.
Genio hyo glossi.
Stylo hyoidei.
Sterno hyoidei.
Omo hyoidei.
Thyro hyoidei.

Muscles arising from the Clavicle.

Pectoralis major - -	Of the shoulder-joint.
Deltoides - - - -	

Sterno mastoideus.
Sterno hyoideus.

Muscles inserted into the Clavicle.

Subclavius.
Trapezius.

Muscles arising from the Scapula.

Omo hyoideus—attaching the scapula to the trunk.

Deltoides - - - - -	Of the shoulder-joint.
Supra spinatus - -	
Infra spinatus - - -	
Subscapularis - - -	
Teres major - - -	
Teres minor - - -	
Coraco brachialis -	
Latissimus dorsi - -	
Biceps - - - - - -	Of the elbow-joint.
Triceps - - - - - -	

Muscles inserted into the Scapula.

Levator scapulæ - -	Muscles attaching the scapula to the trunk.
Rhomboideus major -	
Rhomboideus minor -	
Serratus anticus - -	
Pectoralis minor - -	
Trapezius - - - -	

Muscles arising from the Humerus.

Brachialis internus -	Of the elbow-joint.
Triceps - - - - - -	
Anconeus - - - - -	
Pronator radii teres - - - -	Of the radio ulnar articulations.
Supinator radii longus - - -	
Supinator radii brevis - - - -	
Flexor carpi radialis - - - -	Of the wrist-joint.
Palmaris longus - - - - -	
Flexor carpi ulnaris - - - -	
Extensor carpi radialis longior -	
Extensor carpi radialis brevior -	
Extensor carpi ulnaris - - - -	
Flexor digitorum perforatus - -	Common to the fingers.
Extensor digitorum communis -	

Flexor longus pollicis—proper to the thumb.

Muscles inserted into the Humerus.

Deltoides	Of the shoulder-joint.
Supra spinatus	
Infra spinatus	
Teres minor	
Subscapularis	
Pectoralis major	
Latissimus dorsi	
Teres major	
Coraco brachialis	

Muscles arising from the Radius.

Flexor sublimis digitorum—common to the fingers.

Flexor longus pollicis	Proper to the thumb.
Extensor primi internodii	

Muscles inserted into the Radius.

Biceps—of the elbow-joint.

Pronator radii teres	Of the radio ulnar joints.
Pronator quadratus	
Supinator radii longus	
Supinator radii brevis	

Muscles arising from the Ulna.

Supinator radii brevis	Of the radio ulnar articulations.
Pronator radii teres	
Pronator quadratus	
Flexor carpi ulnaris	Of the wrist-joint.
Flexor carpi radialis	
Extensor carpi ulnaris	
Flexor sublimis digitorum	Common to the fingers.
Flexor profundus digitorum	
Extensor primi internodii pollicis	Proper to the thumb.
Extensor secundi internodii pollicis	
Extensor tertii internodii pollicis	

Extensor indicis—proper to the fore finger.

Muscles inserted into the Ulna.

Brachialis internus - - - - - Anconeus - - - - - - - - Triceps - - - - - - - - -	Of the elbow-joint.

Muscles arising from the Os Pisiforme.

Abductor minimi digiti—proper to the little finger.

Muscles inserted into the Os Pisiforme.

Flexor carpi ulnaris—of the wrist-joint.

Muscles arising from the Os Trapezium.

Flexor primi internodii pollicis - Flexor secundi internodii pollicis Abductor pollicis - - - - -	Proper to the thumb.

Abductor indicis—proper to the fore finger.

Muscles inserted into the Os Trapezium.

Extensor primi internodii pollicis.

Muscles arising from the Os Trapezoides and Os Magnum.

Flexor secundi internodii.

Muscles arising from the Os Unciforme.

Flexor secundi internodii pollicis.
Flexor brevis minimi digiti.
Abductor minimi digiti.

Muscles arising from the Metacarpal-bone of the Fore Finger.

Interossii.

Muscles inserted into the Metacarpal-bone of the Fore Finger.

Flexor carpi radialis.
Extensor carpi radialis longior.

Muscles arising from the Metacarpal-bone of the Middle Finger.

Adductor pollicis.
Interossii.

Muscles inserted into the Metacarpal-bone of the Middle Finger.

Extensor carpi radialis brevior.

Muscles arising from the Metacarpal-bone of the Ring Finger.

Interossii.

Muscle arising from the Metacarpal-bone of the Little Finger.

Interossei.

Muscles inserted into the Metacarpal-bone of the Little Finger.

Adductor minimi digiti.
Extensor carpi ulnaris.

Muscles arising from the First Phalanx of the Thumb.

Abductor indicis.

Muscles inserted into the Phalanges of the Thumb, and their Ossa Sessamoidea.

Flexor primi internodii - - Extensor primi internodii -	To the first phalanx.
Adductor pollicis Abductor pollicis	To the ossa sessamoidea, between the first and second phalanges.
Flexor secundi internodii - Extensor secundi internodii	To the second phalanx.
Flexor tertii internodii - - Extensor tertii internodii -	To the third phalanx.

Muscles inserted into the Phalanges of the Fore Finger.

Lumbricales.
Extensor indicis.
Abductor indicis.
Extensor digitorum communis.
Flexor sublimis perforatus.
Flexor profundus perforans.

Muscles inserted into the Phalanges of the Middle and Ring Fingers.

Lumbricales.
Flexor sublimis perforatus.
Flexor profundus perforans.
Extensor digitorum communis.

Muscles inserted into the Phalanges of the Little Finger.

Lumbricales.
Flexor brevis minimi digiti.
Abductor minimi digiti.
Extensor digitorum communis.
Flexor sublimis perforatus.
Flexor profundus perforans.

Muscles arising from the Spine.

Trapezii.
Latissimi dorsi.
Rhomboidei majores.
Rhomboidei minores.
Levatores scapulæ.
Serrati postici superiores.
Serrati postici inferiores.
Splenii.
Sacro lumbales.
Longissimi dorsi.
Spinales dorsi.
Cervicales descendentes.

Transversales colli.
Trachelo mastoidei.
Complexi.
Recti capitis postici majores.
Recti capitis postici minores.
Obliqui capitis superiores.
Obliqui capitis inferiores.
Semispinales dorsi.
Semispinales colli.
Multifidi spinæ.
Intertransversales.
Interspinales.
Levatores costarum.
Obliqui abdominis interni.
Longi colli.
Recti capitis anteriores majores.
Recti capitis anteriores minores.
Recti capitis laterales.
Diaphragma.
Psoæ magni.
Iliaci interni.
Psoæ parvi.
Scaleni antici.
Scaleni medii.
Scaleni postici.
Transversales abdominis.

Muscles inserted into the Spine.

Splenii colli.
Sacro lumbales.
Longissimi dorsi.
Spinales dorsi.
Cervicales descendentes.
Transversales colli.
Obliqui capitis inferiores.
Semispinales dorsi.
Semispinales colli.

Multifidi spinæ.
Intertransversales.
Interspinales.
Longi colli.
Quadrati lumborum.

Muscles arising from the Sternum.

Pectorales majores.
Sterno cleido mastoidei.
Sterno hyoidei.
Sterno thyroidei.
Sterno costales.
Diaphragma.
Intercostales interni.

Muscles inserted into the Sternum.

Recti abdominis.
Obliqui abdominis interni.

Muscles arising from the Ribs.

Intercostales externi.
Intercostales interni.
Diaphragma.
Sterno hyoidei.
Sterno thyroidei.
Subclavii.
Pectorales majores.
Pectorales minores.
Latissimi dorsi.
Serrati majores antici.
Cervicales descendentes.
Obliqui abdominis externi.
Transversales abdominis.

Muscles inserted into the Ribs.

Levatores costarum.
Intercostales interni.

Intercostales externi.
Sterno costales.
Quadrati lumborum.
Scaleni antici.
Scaleni medii.
Scaleni postici.
Serrati postici superiores.
Serrati postici inferiores.
Sacro lumbales.
Accessorii ad sacro lumbales.
Longissimi dorsi.
Obliqui interni abdominis.
Recti abdominis.

Muscles arising from the Sacrum.

Latissimi dorsi.
Obliqui abdominis interni.
Longissimi dorsi.
Sacro Lumbales.
Multifidi spinæ.
Glutæi maximi.
Pyriformes.

Muscles inserted into the Sacrum.

Coccygei.

Muscles arising from the Os Coccygis.

Glutæi maximi.

Muscles inserted into tbe Os Coccygis.

Coccygei.
Levatores ani.
Sphincter ani.

Muscles arising from the Ossa Ilia.

Obliqui interni abdominis - - -	Muscles of the abdomen.
Transversales abdominis - - -	

Latissimi dorsi - - - -	
Longissimi dorsi - - -	
Sacro lumbales - - - -	Muscles of the back.
Multifidi spinæ - - - -	
Quadrati lumborum - -	
Iliaci interni - - - - -	
Glutæi maximi - - - -	
Glutæi medii - - - -	Muscles of the hip-joint.
Glutæi minimi - - - -	
Tensores vaginæ femoris -	
Sartorii - - - - - -	Muscles of the knee-joint.
Recti femoris - - - - -	

Muscles inserted into the Ossa Ilia.

Obliqui externi abdominis.
Psoæ parvi.

Muscles arising from the Ossa Ischia.

Erectores penis - - - -	
Erectores clitoridis - - -	
Transversi perinæi - - -	
Transversi perinæi alteri -	Muscles of the perinæum.
Levatores ani - - -	
Coccygei - - - - - -	
Gemini - - - - - -	
Obturatores externi - -	
Obturatores interni - - -	Muscles of the hip-joint.
Quadrati femoris - - -	
Tricipites adductores femoris	
Graciles - - - - - -	
Bicipites flexores crurum -	Muscles of the knee-joint.
Semitendinosi - - - -	
Semimembranosi - - -	

Muscles arising from the Ossa Pubes.

Recti abdominis - - - -	Muscles of the abdomen.
Pyramidales - - - - -	

Levatores ani—muscles of the perineum.

Obturatores externi - - - -	Muscles of the hip-joint.
Obturatores interni - - - -	
Pectinæi - - - - - - - -	
Tricipites adductores femoris	

Graciles—muscles of the knee-joint.

Muscles inserted into the Pubes.

Obliqui externi abdominis -	Muscles of the abdomen.
Obliqui interni abdominis -	
Transversalis abdominis -	

Psoæ parvi—muscles of the pelvis.

Muscles arising from the Os Femoris.

Cruræus - - - - - - -	Of the knee-joint.
Vastus externus - - - -	
Vastus internus - - - -	
Biceps flexor cruris - - -	
Poplitæus - - - - - - -	
Gastrocnemius externus -	Of the ancle-joint.
Plantaris - - - - - - -	

Muscles inserted into the Os Femoris.

Gluteus maximus - - -	Muscles of the hip-joint.
Gluteus medius - - - -	
Gluteus minimus - - -	
Pyriformis - - - - -	
Geminus superior - - -	
Geminus inferior - - -	
Obturator externus - - -	
Obturator internus - - -	
Quadratus femoris - - -	
Psoas magnus - - - -	
Iliacus internus - - - -	
Pectinæus - - - - - -	
Triceps adductor femoris -	

Muscles arising from the Tibia.

Tibialis anticus - - - -	Of the ancle-joint.	
Soleus - - - - - - -		
Tibialis posticus - - - -		
Flexor longus digitorum -	Common to the toes.	
Extensor longus digitorum		

Muscles inserted into the Patella and Tibia.

Rectus - - - - - - -	Extensors of the knee-joint.
Cruralis - - - - - - -	
Vastus externus - - -	
Vastus internus - - - -	
Semimembranosus - - -	Flexors of the knee-joint.
Semitendinosus - - - -	
Sartorius - - - - - - -	
Gracilis - - - - - -	
Popliteus - - - - - - -	

Muscles arising from the Fibula.

Peroneus longus - - -	Extensors of the ancle-joint.
Peroneus brevis - - - -	
Soleus - - - - - - - -	
Tibialis posticus - - - -	
Flexor longus pollicis pedis	Proper to the great toe.
Extensor longus pollicis pedis	

Extensor longus digitorum—common to the toes.

Muscles inserted into the Fibula.

Biceps flexor cruris—flexor of the knee.

Muscle arising from the Astragalus.

Extensor brevis digitorum pedis.

Muscle inserted into the Astragalus.

Tibialis posticus.

Muscles arising from the Os Calcis.

Extensor brevis digitorum pedis—on the dorsum.

Flexor brevis pollicis - -	On the plantar region.
Abductor pollicis - - -	
Adductor pollicis - - -	
Flexor brevis digitorum pedis	
Flexor digitorum accessorius	
Abductor minimi digiti - -	

Muscles inserted into the Os Calcis.

Gastrocnemius - - - -	Extensors of the ancle-joint.
Plantaris - - - - - -	
Soleus - - - - - - -	

Muscle inserted into the Os Naviculare.

Tibialis posticus.

Muscles arising from the Ossa Cuneiforme.

Flexor brevis pollicis pedis	Os cuneiforme externum.
Adductor pollicis pedis -	

Muscles inserted into the three Ossa Cuneiformia.

Tibialis anticus—to the internal cuneiform bone.
Tibialis posticus—to the internal and middle.
Peroneus longus—to the os cuneiforme internum.

Muscles arising from the Os Cuboides.

Adductor pollicis pedis.
Flexor brevis minimi digiti.
Flexor brevis pollicis pedis.

Muscles arising from the Metatarsal-bones.

Interossei - - - - - -	Common to all.
Transversus pedis - - -	

Adductor pollicis pedis—from second, third, and fourth.

Flexor brevis minimi digiti pedis	From the fifth.
Abductor minimi digiti pedis - -	

Muscles inserted into the Metatarsal-bones.

Tibialis anticus - - - - Peroneus longus - - - - Adductor pollicis pedis -	Into the first.
Tibialis posticus—into the second and middle.	
Peroneus brevis - - - - Peroneus tertius - - - - Flexor brevis minimi digiti Abductor minimi digiti - -	Into the fifth.

Muscles inserted into the Phalanges of the Toes.

Flexor longus digitorum pedis Flexor brevis digitorum pedis Lumbricales - - - - - Extensor longus digitorum Extensor brevis digitorum - Interossei - - - - - -	Common to the toes.
Flexor longus pollicis pedis Flexor brevis pollicis pedis Abductor pollicis pedis - - Adductor pollicis pedis - - Extensor longus pollicis pedis	Proper to the great toe.
Flexor brevis minimi digiti pedis Abductor minimi digiti - - -	Proper to the little toe.

LECTURES ON ANATOMY.

PART V.

GENERAL ANATOMY OF CELLULAR MEMBRANE, &c.

LECTURE XX.

GENERAL ANATOMY OF CELLULAR MEMBRANE.

Cellular membrane, so named from the peculiarity of its structure, is composed of numerous bluish grey fibres, crossing each other in every direction so as to form thin elastic membranes or plates, which unite, and intersect each other, producing innumerable cells or areolæ, of various shapes and dimensions.

This structure is one of the most important in the human body, both on account of its forming a principal component of every other part, and of the extensive function it performs as an organ of secretion and absorption.

The cellular membrane may, indeed, be regarded as the general basis whereon the other structures are formed, and by which they are supported and connected with each other.

Some physiologists have considered all membranous structures as so many modifications of the cellular membrane; while others have divided the cellular membrane into numerous distinct tissues: of these views, it appears to be too theoretical, on the one hand, to say that the cellular tissue, by being condensed, forms the cutis, which has the power of depositing concrete lamellæ upon its surface, named the cuticle; or, that coiled into tubes, it forms blood-vessels, &c.: so also, on the other hand, it appears to be a useless multiplication of parts, to divide the cellular membrane into the numerous tissues described by Bichat.

In its general distribution throughout the body, some variety may be observed in the different features represented in its physical properties, and function; from which circumstance, for tbe facility of description, it may be considered under the following heads:—

First:—As forming a general covering to the different organs, at the same time connecting them in their relative position to each other, yet allowing of the free motion of their several parts.

Secondly:—It enters into the composition of the minutest structures of the body.

Under the first of these heads, we shall commence by noticing the general covering of cellular membrane, immediately beneath the skin; in this situation it is every where inseparably connected with the under surface of the cutis, and enters so abundantly into the composition of the common integuments, that the true skin itself appears as if it were a condensation of cellular membrane upon the surface of the body. The cells are larger, and more lax, the farther they are removed from the cutis; hence the mobility which the skin enjoys principally depends upon the abundance of cellular membrane underneath. In this respect, the subcutaneous cellular membrane varies according to its situation, being generally admirably adapted to the motions of individual parts: where extensive motion is required, its fibres and plates are longer, and more elastic; while in parts where strength and support are necessary, its fibres are short and dense, and frequently mixed even with tendinous structures. These differences of texture are particularly observable in the palms of the hands, and soles of the feet; it is also dense under the integuments of the cranium, whence the motions of the scalp, from its consequent firm adhesion to the muscles underneath.

The cellular membrane is also found more dense along the mezian line which divides the trunk perpendicularly into symmetrical halves; this line passes along the spinous processes of the vertebræ and sacrum, the raphé of the perineum, scrotum, the linea alba, sternum, and centre line of the face and head. The existence of this line is evinced by the effects of emphysema, which are here checked in their progress; and artificially one half of the subcutaneous cellular membrane throughout the body has been inflated,

independently of the other. On the contrary, this structure is found more lax in the eyelids, the face, the neck, the axilla, the abdomen, the groins, the scrotum, and in the popliteal region.

The next situation in which we shall remark this structure is, in the general covering which it affords to the muscles, independent of its intimate union with their ultimate fibres.

Here also, as in the subcutaneous arrangement, it will be found more abundant in all those parts where motion is most extensive; thus in the muscles of the face, where varied motion is employed in each changing expression of the features; in the neck, where the muscles are numerous, lengthened, extensive in their motions, and accompanied by numerous large blood-vessels; between the muscles of the chest, and around the mammæ; in the axillæ, where large blood-vessels, nerves, absorbents and glands are embedded, between the great muscles of the back and chest; between the muscles forming the parietes of the abdomen; in the groins, bend of the knees; and particularly between the larger muscles of the extremities.

In the soles of the feet, and palms of the hands, the deep-seated cellular membrane, as the subcutaneous, is abundant; but in these situations it is peculiar from enclosing cells of adeps, mixed with strong tendinous fibres, forming a cushion to resist the effects of pressure on the parts underneath; a similar structure is found, for a similar purpose, beneath the tuberosities of the ischia.

We shall next observe the covering which the cellular membrane gives to the viscera, and other important organs situated within the cavities of the body. Hence we may first observe, that the secreting glands are more or less covered with cellular membrane, independent of any motion required in these parts; such, for instance, is the case with the kidney, and capsulæ renales, which are not only furnished with this structure external to their aponeurotic envelops, but also between them and the glands themselves.

The cellular membrane also surrounds the liver, pancreas,

spleen, stomach, intestines, and bladder; and, most abundantly, at those parts where the peritoneum is separated from each organ to allow the passage of their vessels and nerves; as is seen between the folds of the omenta, mesentery, ligaments of the liver, and more especially on that portion of the bladder which is not covered with peritoneum. In the thorax, the cellular membrane will be found connecting the lungs with their pleura, and the heart with its pericardium; and as in the abdomen, is found more abundant where the serous membranes are reflected from their organs for the transmission of blood-vessels, as in the mediastina, and course of the coronary vessels to the heart.

It may be further mentioned here, that the mucous as well as the serous membranes, are attached to their respective organs by a general connecting medium of cellular membrane.

The second general distribution of the cellular mambrane, is that in which it forms so material a part of all the minute structures of the body.

So extensive is this distribution, that the physiologist is unable to say where this structure ends, and other structures commence.

In the muscles we find it, after coating them generally, enclosing their separate fasciculi, becoming thinner and thinner in its texture, as it enters more minutely into the body of each fasciculus, enclosing the minutest fibre traceable with the highest magnifying powers.

With regard to the blood-vessels, it forms a general covering, readily discerned in the larger branches; and when we consider the extent of the cellular membrane accompanying them to their ultimate ramifications, we are lost in the contemplation of its infinite minuteness and delicacy; and this is still further evinced, when we consider that a much finer layer of cellular membrane connects the internal with the muscular coat of the arteries. The same observations apply to the distribution of the cellular membrane accompanying the nervous system; we are enabled to trace it in the

larger nérves giving them a strong and general covering, as in the muscles; it then incloses their minuter fasciculi, and subdivides, accompanying them to their minutest filaments.

The cellular membrane covering the absorbents is very abundant; but in close contact with the vessel, it is short and dense, and not so easily traced as in the arteries and nerves. The same remark applies to the veins; but there, however, it is more distinct than in the absorbents, from the structure of the coats of the vessels. In the substance of the glands, we find the cellular membrane less abundant, and composed of very short and delicate fibres, apparently coating the minute globules of their interior structure; this may be easily seen by tearing the substance of the liver and spleen, when minute and semitransparent fibres will be seen to separate themselves from between each globule, apparently uniting as well as surrounding them. This cellular structure of the liver is rendered particularly obvious by placing a portion in pyrolignious acid, and allowing it to remain for six weeks or two months subjected to its action; a species of decomposition will take place, by which each distinct globule is detached, and the structure of the liver beautifully demonstrated.

The minute, or ultimate structure of cellular membrane, is not clearly understood; by the assistance of the microscope we may trace innumerable whitish grey fibres, crossing each other in all directions, and by their union forming thin delicate membranes or plates; these again meet and intersect each other, so as to produce cells or areolæ. Whether these whitish fibres are blood-vessels, absorbents, or nerves, is not known, excepting from the evidence of secretion and absorption, abundantly carried on in this structure; which functions lead to the conclusion, that it must be plentifully supplied with such vessels.

With regard to the texture of the cellular tissue, it is extremely elastic; its cohesive force, however, varies; being that of a coagulated liquid in some parts of the body, whilst

in others its power of resistance equals that of perfect fibres: for instance, the cellular membrane in the interior of a muscle, appears principally for the connection of its parts, and is there more distinctly fibrous: while in the axilla, and those parts destined for extensive motion, it not only forms a connecting medium, but secretes a halitus to lubricate its surface, and presents, when floated in water, a peculiar soft flosculent appearance.

The cellular membrane has a free communication between its cells, as is seen in emphysema, ecchymosis, and anarsarca; but some difference of opinion exists regarding the free permeability of this structure, it having been supposed by some physiologists that each cell naturally secretes and reabsorbs individually, and it is only in a state of disease that a free communication and infiltration takes place. This variance in opinion seems to me to be decided by the fact, that in artificial, or accidental inflation, the air is readily reabsorbed without any ill effects; a circumstance which we could not suppose would take place under even slight laceration of parts.

The cellular membrane derives its arteries from the minutest branches, which, in most situations, seem only capable of circulating the colorless parts of the blood. This arterial distribution must not be confounded with the numerous branches which are transmitted and protected in their passage to other structures. The arteries themselves receive their vasa vasorum entirely from the vessels of the surrounding cellular membrane; hence an artery dies when deprived of its cellular covering.

Nerves, in a like manner, may be traced through cellular membrane, in their course to other structures; but it remains uncertain whether this tissue itself possesses any nerves; and we are led to this conclusion, as it does not manifest any sensibility, excepting in a state of inflammation, when the degree of sensibility may probably depend upon the tension produced by its swelling on the other parts in connection with it. This opinion is strengthened by the

fact, that immediate ease is obtained by such surgical means as relieve pressure upon the part.

The chemical composition of the cellular membrane is difficult to trace, in consequence of its intermixture with blood-vessels, absorbents, and nerves. It consists principally of gelatine and mucus. By boiling, it by degrees will dissolve to gelatine; this is exemplified by the boiling of flesh, when the fibres of the muscle become separated into distinct fasciculi as the cellular membrane is dissolved.

The functions of the cellular membrane, independent of the support and free motion which it affords to the different structures of the body, consists of various secretions and absorptions. It is probable, that the insensible perspiration, at all times carried on, forms one of the principal excretories of its secretions; from which circumstance, there is a resemblance between the cellular and mucous membranes: but as absorption, as well as secretion, is constantly carried on, in that respect its functions resemble more those of serous membranes; hence there is a difficulty in assigning it to either class.

The secretion of serum in the living body, is in a state of vapour, or halitus, as may be seen on opening the body of an animal recently slain; this vapour quickly condenses on exposure to the atmosphere. The accumulation of this secretion, whether depending on the diminished action of the absorbents, or the excessive deposition from the arteries, produces anasarca; such collections are found most extensive in all situations where the cellular membrane is lax, and in abundance, particularly in the eyelids, prepuce, and scrotum; but where the cells are composed of dense and short fibres, they seldom or never fill, either in emphysema or anasarca. This is particularly the case in all the submucous and subserous cellular distributions; in the palms of the hands, and in the soles of the feet. And it may be further remarked, that in these situations, as well as around blood-vessels, the cellular membrane not only differs in the

absence of serous infiltrations; but in the absence of adipose cellular membrane.

It appears that, during sleep, the secretion of serum is increased, as is seen by the moisture on the surface of the skin. The important function of decarbonizing the blood, may be thus effected when the lungs, and other vital organs, are in comparative quiescence.

The cellular tissue is one of the structures earliest developed; in the fœtus, it is at first abundant and in a semi-fluid palpy state; it then diminishes as the organs develope themselves, and at the same time as growth advances, its density increases. In the female it is more abundant and lax than in the male.

The cellular membrane has a greater power of reproduction, than almost any other structure in the body; and to it probably may be attributed the process of reparation of divided parts. The phenomena which occur in the union of divided cellular membrane when brought into immediate contact, consist, first, of the pouring out of a fluid, which soon has vessels shooting into it; and consolidating, the whole becomes highly vascular: this new structure remains for some time firmer, and more vascular, than the originally formed membrane; but, by degrees, it is not distinguishable from it. In large and extensive wounds, in which the edges are widely separated, a similar process occurs in the formation of granulations; and the readier process of growth in cellular membrane beyond that of the skin, is often witnessed in the exuberance of granulations before the new skin is capable of covering them.

The cellular membrane is frequently the seat of inflammation, which produces an adhesive deposit, and consequent consolidation, which diminishes the elasticity and power of motion in the part. Inflammation, in other instances, extends to suppuration; and in consequence of the slight degree of vitality of this structure, and the free communication of its cells, extensive abscesses follow, which are

limited by a wall of adhesive inflammation, which sooner or later circumscribes the matter, according to the state of health of the individual.

When abscess is of slow formation, its cavity is sometimes lined with a membrane, presenting a secreting surface, connected to the surrounding parts by a compact cellular membrane; such is particularly the case in fistulas and sinuses—these are difficult to obliterate, until, by injection or division, a new character is given to their surfaces.

Inflammation of the cellular membrane sometimes terminates in the death of the part, when nature immediately endeavours to set up the process of separation; but, from the unyielding nature of the skin, this process is slow and tedious, and high constitutional irritation follows, generally accompanied with diminished power: such is the state in carbuncle, the means of treating which, consists in early crucial incisions through the skin, stimulating poultices, and every remedy which will hasten the separation of the dead part, and check the ill effects of constitutional irritation.

Elephantiasis, a disease common in the West Indies, has its seat in the cellular membrane, and is produced by the deposition of a gelatinous fluid into its cells, which increases the bulk of the diseased limb to an enormous size. It is not improbable, that this disease is owing to a specific inflammation depending on a derangement of the perspiratory function; the climates in which it is mostly found, are those which produce the most violent perspiration; and sudorifics, which tend to restore this function of the cellular membrane and the skin, are the remedies most beneficial in its treatment.

The importance of the function of this structure is proved by the remarkable manner in which it sympathises with the diseases of different, though distant organs; particularly those connected with respiration, and urinary secretion.

This is also witnessed by the great proportion of the chronic diseases of the heart, liver, and spleen, terminating in anasarcous effusions.

From accidental causes extravasation of blood sometimes takes place into the cellular membrane producing ecchymosis. Extravasation of other fluids may also occur; these fill the cells, in which they produce a greater or less degree of inflammation, depending on the quantity and quality of their nature; the most severe of which is from extravasation of urine.

Occasionally needles find their way into the cellular membrane, and traverse the body in a remarkable manner through its substance; they do not find their way from cell to cell, but are supposed to be moved by particular processes of inflammation,—ulcerative inflammation in front, suppurative on the surface in contact with the needle, and the adhesive behind.

Other foreign bodies, such as bullets, are occasionally lodged in the cellular membrane; when a membrane encloses them, which supports them in their situation, and prevents them from irritating the parts around. Should, however, inflammation be set up from any accidental cause, they will occasionally change their situation, or be thrown out from the body.

Adipose Membrane.

Is so called from the adeps, a peculiar substance it secretes. Whether this is a distinct membrane from the cellular, is a point by no means clearly ascertained by physiologists; the only grounds for such an hypothesis seem to arise from the peculiar form in which adeps is deposited, being invariably in grains, of a rounded or ovoid shape, attached at one extremity by a peduncle, supposed to be formed of its secreting vessels. It is questionable whether each granule is enclosed in a distinct envelope of membrane, which existed prior to the secretion of the fat; or whether it is derived from a secretion simultaneous with that of the adeps; and as it does not appear that any anatomist has been able to demonstrate this adipose membrane independent of the secretion of adeps, and as it is allowed by Béclard, Bichat,

and others, that this structure is absorbed with its adipose contents: it is to me more than probable, that adeps is a peculiar granular secretion from the common cellular membrane. This structure is sufficient to account for the circumstance, that adeps does not infiltrate from one cell to another, although in a semifluid state. In every situation where adeps is found in the human body, it assumes aggregates of these minute globules, formed precisely according to the shape of the cells of the cellular membrane which encloses them; these masses are of various forms and sizes, depending upon the function and motion of the parts to which they are attached.

To suppose that adeps is secreted by a distinct membrane from the common cellular structure, involves the difficulty of demonstrating a second cellular, or adipose apparatus; which, from the variety of situations in which fat is found, would be almost as general as the distribution of the demonstrable cellular membrane; it is therefore more probable, that the cellular membrane appertains to the formation of fat, as well as the other structures of the body.

The existence of a distinct capsule to each granule of fat, is not equally demonstrable in every part of the body; and if we may suppose that the common secretion of the cellular membrane does surround each granule as it is formed, its fluid nature would tend alone to preserve the globular form of the oily secretion. On holding a piece of beef suet to a lighted candle, its surface will melt, and the granular structure immediately disappears; a circumstance which could hardly take place, if the capsule in every situation existed.

Malphigi tells us, that fat is formed of grains appended to the blood-vessels; Swammerdam, that it is a fluid oil contained in membranules. W. Hunter was the first to assert, that the cells containing fat do not communicate with each other in the same manner as those which contain serum. It is evident, that but little is known upon this subject; and wherever such is the case, each physiologist

appears to indulge his imagination, under the assurance, that while nothing is certainly known, one conjecture has as fair a chance of belief as another.

Whether we consider the adipose membrane distinct or not from the cellular membrane, wherever fat is secreted blood-vessels may be easily injected. The terminations of absorbents in this structure, have not been demonstrated; but from the quick absorption of adeps, under various circumstances, their existence cannot be doubted.

The evidence of the existence of nerves in the adeps, is also a matter of doubt.

Adeps is secreted in different parts of the body; it is found abundant under the skin; a mass of fat is situated in the orbit, and between the muscles of the cheeks; the back of the neck contains a greater quantity than its front part; both the external and internal surfaces of the chest are furnished with fat, as may be seen around the heart, between the pectoral muscles, and around the mammæ. In the abdomen, it is seated around the kidnies; in the substance of the mesentery, and omenta, within the pelvis; and around the pubes. On the extremities this tissue is abundant, in the bending of the joints, and in those parts subjected to pressure, as on the buttocks, and soles of the feet.

The accumulation of adeps, takes place in different parts of the body at various periods of life. In the fœtus, after the fourth month of uterine gestation, it begins to accumulate under the skin, where it is deposited in minute rounded masses; and is then absent from nearly all those parts where it is accumulated at the adult period. In the adult, it is found in the abdomen, around the kidneys, mesentery, and omentum.

In old age, this substance is nearly absorbed, leaving first the external surface of the body; but still remains around the viscera of the abdomen, around the heart, in the cavities of the bones, and substance of the muscles.

There are certain situations in the body in which fat is

never secreted, as under the scalp, eyelids, nose, ear, scrotum, prepuce, nymphæ; on the external surface of the body, and internally in the substance of the uterus, liver, spleen, and between the coats of the stomach, and intestines.

The secretion of adeps is of considerable importance in the animal economy; it may be said to form a source of nutrition when the stomach and intestines are deranged in their natural functions; it forms a protection against the effects of cold, particularly in children, who, possessing such a clothing of subcutaneous fat, are liable to resist the effects of cold in a remarkable manner; while, on the contrary, those who are emaciated, from protracted disease or from age, are painfully sensible to the vicissitudes of temperature. It may be observed, that the secretion of adeps is more abundant towards winter; and this is particularly observable in certain birds, quadrupeds, and hybernating animals.

Fat, in its formation, answers a most essential purpose, not only as a source of nutrition, but for the office which it performs in disposing of a considerable quantity of carbon, which materially contributes to the purifying of the blood; hence it is that we see persons, who are confined in unhealthy situations and impure air, frequently become loaded with unhealthy fat.

The quantity of fat in a healthy adult, amounts to one twentieth part of the weight of the whole body; but, at times and from causes not understood, it will accumulate even to the surprising quantity of four-fifths of the weight of the body.

The circumstances which tend to an accumulation of fat, are indolence of habit, rest of body, and ease of mind. Castration, also, increases the growth of fat; probably from the diminished excitability of animals under such circumstances.

It is remarkable, that great growth of fat in the female obstructs the generative powers; this is observed in domestic

fowls, which, in proportion as they are fattened, are less capable of laying eggs.

The circumstances which diminish the tendency to the formation of fat, are violent exercise, great activity of mind and body, abstinence, and increased perspiration. A diseased state of the vital organs, and more especially those of digestion, occasions a rapid absorption of fat.

There are sometimes partial accumulations of fat, forming very large tumours, in various situations of the body, but most commonly under the skin; these are termed steatometa; they are generally of a rounded form, communicate a doughy feel to the touch, and are perfectly free from pain, producing no other inconvenience than from their weight. Such tumours are sometimes placed between the peritoneum and abdominal muscles, where they are of more importance, from their pressure on the viscera. They are enclosed by a cellulous envelope, occasionally of considerable thickness, and containing blood-vessels, which are in proportion to the size of the tumour; although at the same time these tumours have fewer and smaller vessels than any other.

The adeps contained in these tumours appears the same in every respect as healthy fat in other parts of the body, unless it be found somewhat more consolidated from pressure. In old persons, the muscles are occasionally filled with fat, and are of a white colour; whence has arisen the supposition, that they have changed into fat: but this is never the case, as the fibrous structure of the muscle, although altered in appearance, always remains.

In local inflammation, where the adipose tissue is most abundant, gangrene frequently occurs, from the little vitality of this structure; this is frequently seen in large umbilical herniæ, where portions of fat omentum are left in the sac, when it is found readily to sphacelate; and a considerable quantity of adeps escapes in a fluid state, leaving the membrane behind, which is slower in its ulcerative process of separation; but sometimes remains as an organized part within the sac.

Adeps is found in various parts of the body, forming morbid affections; these occur in the ovaria, and form encysted tumours in the neighbourhood of serous membranes.

The medullary substance of the cavities of the bones, which so much resembles the adeps, both in its composition and in the cellular membrane which encloses it,—has been noticed, when treating of osteology.

LECTURE XXI.

GENERAL ANATOMY OF THE SKIN OR COMMON INTEGUMENTS.

Under this title, we shall consider those integuments which form the exterior covering of the body; and although many anatomists and physiologists have classed the mucous membranes as a continuation of the same structure; their variety of function is so great, that the mere circumstance of the imperceptible blending of the one into the other, is hardly sufficient to identify them as being the same. On the contrary, there is a marked difference both in the physical and vital properties, between a surface destined to be in contact with atmospheric air, and a surface lubricated by mucus, which enables them to bear the contact of fluids, and stimulants of various descriptions. The line of demarkation between the tegumentory coverings of the exterior and interior of the body, is sufficiently obvious; as in the eyes, nose, lips, anus, and in those situations where mucous secretions commence; although the cuticle, or external layer of the skin, does proceed and may be traced into the interior of some of those cavities which are exposed to a variety of stimulants, as in the alimentary canal. It is further distinguished from the mucous membranes by containing fewer blood-vessels, and by being more dense.

The skin is the strong elastic external covering of the body, formed both to afford support, and to allow of the free motions of its several parts. It is found to cover the whole of the external surface of the body, but presents varieties of structure in different situations; on the posterior surface of the body, it is thicker than on the anterior, and on the external surface of the limbs than on the internal; and

more particularly where subjected to pressure, its thickness will be considerably increased, as on the palms of the hands, and soles of the feet. The skin is connected with the parts underneath by means of cellular membrane, which is more or less abundant according to the extent of motion the subjacent parts are liable to. In this attachment, the skin of the body presents a mezian division by a line of closer and firmer texture, which extends along an imaginary vertical line, dividing the trunk into symmetrical halves; but which line, externally, is interrupted by the natural outlets of the body; although in fact, as has been mentioned, it passes into these orifices to be connected with the mucous membranes.

To the elasticity of the skin we are indebted, in a great measure, for the symmetry and form of the body; were it not for this physical property, in every distortion, the skin would require some new vital action to restore it to its natural situation. In the extensive motions of the various joints of the body, the skin arranges itself into numerous wrinkles, corresponding precisely with the centre of motion of each joint; and where the skin is under the influence of muscles, the wrinkles will correspond with the direction of their contractions, as may be seen particularly on the forehead, eyelids, neck, and other parts of the body. These wrinkles must not, however, be confounded with those of old age, which depend upon the general shrinking of the whole fabric.

The surface of the skin presents numerous minute openings, of a rounded shape, which are the excretories of the sebaceous follicles; these are very generally distributed, but are most abundant on the nose and face: there are also smaller openings, which are scarcely perceptible without the assistance of a microscope; these are the perspiratory pores: the skin is also penetrated by the hairs which pass through its substance. The color of the skin varies in different parts of the body; it is darker on the scrotum, perineum, upper part of the inside of the thighs, and in the

axilla; probably depending on the secretions of these parts to defend them from friction. Its colour also varies from the influx of blood into its vessels; this is particularly obvious about the face and neck, as is evinced by blushing, and the various tints produced by morbid affections. There are still further varieties of colour, characteristic of the different races of mankind: these varieties are white, in the European; black, in the African Negro: and there are intermediate shades, as copper-colour, tawny, &c.: in these varieties, the colour of the hair generally corresponds with that of the skin.

A vast variety of hypotheses have been advanced respecting the structure of the skin; on the most minute examination, it is divisible into three distinct structures,—the cutis, rete mucosum, and cuticle; each of which we shall describe separately.

The Cutis.

The cutis is placed between the rete mucosum, which is on its external, and the cellular membrane, which is attached to its internal surface; its external surface presents a white mass, of a uniform dense consistence, composed of numerous fibres, crossing each other in every possible direction so as to form a compact solid substance; this compact texture of fibres, which has not inaptly been compared to felt, becomes looser on its internal surface, where the fibres are longer; and beginning to form cells, gradually enlarge until they are blended and confounded with the cellular membrane. On the quantity and density of this compact structure, depends the degree of strength, elasticity, and various thicknesses of the skin in man, and other animals. This structure of the cutis may readily be examined in any one of the different species of tanned leather in common use. (*Vide Plate* II. *Fig.* 7.)

The external surface of the cutis presents innumerable minute sulci, or fossæ, which cross each other in a variety of directions, giving it a net-like appearance of uneven meshes; these sulci generally assume a direction corresponding to the habitual motion of individual parts. Between

these sulci or fossæ the surface of the cutis projects in corresponding eminences, which are again subdivided by minuter eminences, of a somewhat vermicular character, on the general surface of the body (*Vide Plate* II. *Fig.* 3.), but arranged in parallel structures on the palms of the hands, and soles of the feet; and more particularly apparent on the extremities of the fingers and toes. (*Vide Plate* II. *Fig.* 1 *and* 4.)

These minuter divisions are, perhaps, the true papillæ of the skin, and the particular surface in which the sense of touch resides, and through which the perspirable pores pass; they are found particularly sensible at the extremities of the fingers and toes; in the former of which they are rendered more sensible, as organs of touch, from their habitual use; they are also exquisitely sensible on the lips, where they are arranged in such a manner that their apices are directed forwards; so that when the lip is drawn backwards, the sensation is increased by a larger surface of each papilla being exposed to contact. A similar arrangement of the papillæ is found in the skin of the glans penis, where they are all turned towards the extremity of the urethra; so that when the prepuce is drawn backwards, the papillæ are subjected to friction, and their sensibility increased. The papillæ over the whole surface of the body possess a similar sense of touch, but differing in degree, according to the frequency of exertion; we have more or less a proof of this supposition from the circumstance, that exquisite sensibility may be acquired in different parts of the body under habitual exertion, when the upper extremities are disabled.

The skin, besides this organization, possesses secreting structures of three kinds:—

First, the perspiratory pores; these are situated by the sides of the papillæ, and may be seen with the assistance of a common lens, having the appearance as if the cutis had been punctured with a needle; through which openings the perspiration may be seen to collect in minute globules.

Secondly; there are follicles, which are openings communicating with minute cavities under the cutis, which secrete a sebacious oily matter. The use of this secretion seems to be for the purpose of lubricating the surface of the skin, and of defending it from the vicissitudes of temperature.

Thirdly; in some parts of the body there are little glandular structures found underneath the skin, which are termed miliary glands; they are abundant in the axilla, and on the prepuce; they are for the purpose of defending the skin, by an oily secretion, from the effects of perspiration. This secretion is of a peculiar fœtid smell, particularly in those who are not cleanly in their persons.

The cutis is a highly organized substance; its *arteries* are extremely minute and numerous, as may be seen in successful injections; their principal accumulation is on its external surface, where they are seen to intersect and anastamose with each other in a great variety of directions; in some instances, apparently taking the form of the meshes; in others, terminating in minute bundles, which present distinct spots of congregated vessels. I have great reason to think, that many of the beautiful injected preparations of the skin at the College of Surgeons, and other museums, are in some instances successful, not only in the true skin, but in the rete mucosum on its surface; in the latter of which the above-mentioned appearance is always more or less apparent.

The *veins* of the cutis are also exceedingly numerous, and are larger than the arteries, take a similar mesh-like direction, and probably terminate in a peculiar structure immediately underneath the cuticle; being furnished with valves, they are much more difficult to inject than the arteries, but have occasionally been so demonstrated on the prepuce.

The *absorbents* on the surface of the cutis, are not easily demonstrated; although in the cellular membrane immediately underneath, they are numerous, large, and easily injected.

The *nerves* are numerous, and are distributed to the cutis

in abundance, communicating great sensibility, so as to produce most painful sensations in cutting the cutis, or exposing it by abrasion of the cuticle.

The distribution of the nerves in the cutis is of great importance in the animal economy, as forming the seat of the sense of touch; very little is known of the real nature of this function, beyond its connection with the vital principle. It has been stated by physiologists, that each of the papillæ consists of a spongy elevation of the cutis, into which projects the soft and sentient extremity of a nerve enclosed in some erectile tissue; these, however, are only assertions, unsupported by any anatomical demonstration. Contact appears to be necessary to the production of the sense of touch, but to what extent the cuticle is connected with the sentient extremities of the papillæ is unknown; and whether it admits of the papillæ being projected through corresponding openings, to form a contact to produce the sensation of touch, is also unknown. The ready manner in which the mind distinguishes the different forms and consistencies of bodies through the medium of the sense of touch, proves the efficiency of this apparatus of nervous distribution to be very different from the distribution of those nerves which only experience painful sensation from their contact with foreign bodies.

In some animals, the surface of the cutis presents a curious structure of papillæ, which coat it externally; they are of a whitish appearance, broad at their base, terminating in minute points, which appear to project into the substance of the cuticle, and would give one the idea, that if the sense of touch resides in these papillæ, that a similar structure may exist in the human subject, although too minute to be demonstrated. This structure is beautifully seen in different preparations of the common integuments of the whale tribe, in the Museum of the Royal College of Surgeons.

The Rete Mucosum

Is situated immediately on the surface of the cutis, be-

tween it and the cuticle. The difficulty which attends the dissection and demonstration of this membrane, has given rise to various conjectures respecting its nature and particular structure. Hence the great variety of opinions between those physiologists who describe the rete mucosum as being composed of three distinct layers; while there are others of equal eminence, who deny its existence altogether. According to the result of my own investigation, the following structure appears to be demonstrable.— To shew the rete mucosum, a piece of healthy black skin, just removed from the body after an operation, should be immersed in boiling hot water, and then thrown into alcohol. The cuticle may now be carefully pealed off, leaving the rete mucosum on the surface of the cutis; and when this has been done, its structure is visible (*Vide Plate* II. *Fig.* 8.), and appears to be composed of a net-work of veins, assuming a peculiar inosculation, differing from that of arteries. It is characterized by frequent, short, anastamosing branches, uniting nearly at right angles, or rather forming figures in which right angles predominate; while, on the contrary, arterial inosculations form figures, in which acute angles predominate; and these are seen, in the minute injections of the arterial distribution, on the surface of the cutis. (*Vide Plate* II. *Fig.* 9.) The venous structure is situated immediately underneath the cuticle, and exterior to the minute arterial distribution on the surface of the cutis; and appears to be the true seat of colour of the skin. There are two preparations in which this structure is very successfully demonstrated; the one may be seen in the Museum of the College of Surgeons, and the other at Guy's Hospital; the representation, Plate II. Fig. 8, is taken from the latter, magnified in the proportion of one inch to one-eighth of an inch.

This structure appears to be much thicker in the Negro than in the European, and the vessels themselves much larger. In the preparation above alluded to, in the College of Surgeons, it is so thick at one portion, as very much to resemble the rete mucosum of the cetacei.

There is considerable difficulty in separating the cuticle from the rete mucosum, in consequence of its firm adhesion; and in those preparations which are even most successful, portions of it will be seen adhering to the raised cuticle. The process of putrefaction seems to go on more readily in this structure than either in the cuticle or cutis, which occasions the ready separation of the cuticle, and probably explains the reason why, in this separation, the rete mucosum is not discernable, but merely a mucous deposit adhering both to the surface of the cutis and cuticle. These surfaces have, therefore, been described as separate layers; while the colouring matter, which is well known to exist, has been assigned to the space between them; thus giving rise to the supposition, that rete mucosum is formed of three separate layers of membrane.

As the seat of colour, the rete mucosum has an undeniable existence; and it is clear, that the cuticle possesses a semi-transparency, through which this colour is more or less discernable. The black colour of Negroes depends on the black colour of the rete mucosum, seen through the cuticle; in Europeans, also, various shades of colour are found, generally according with the colour of the hair, and eyes; these various shades may be observed in the different gradations between a fair and brunette's complexion; the former, generally with light blue; the latter, with dark eyes, and jet black hair. It is generally said, that the rete mucosum is wanting in the Albino, and in white animals of other species. It does not however, accord with the usual operations of nature, to have any structure entirely wanting: it may exist in a colourless state, and in a very small quantity; still smaller than in the European, where it is evidently less than in the Negro.

Five principal shades have been enumerated as characteristic of the several races of mankind. In the Caucasian, white; in the Mongolian, yellow; in the Æthiopian, jet black; in the American, copper colour; in the Malayan, tawny, or resembling dark mahogany.

The Epidermis, or Cuticle,

Forms the external surface of the skin; it is a semi-transparent insensible membrane, and seems destined principally for the purpose of protecting the more sentient parts underneath from the action of the air.

A vast variety of hypotheses have been formed respecting the structure of the cuticle; but upon minute examination, the following appearances present themselves. It every where partakes of the true form of the skin underneath, dipping into its interstices and minute fossæ, in precise conformity with the fossæ and wrinkles which are adapted to the mobility of the skin.

In a like manner to the cutis, the cuticle differs in its thickness and structure in different parts of the body. In the soles of the feet, and in the palms of the hands it is arranged in rugæ parallel to each other, and which take various directions according to the form of each part; on the tips of the fingers and toes, the rugæ are nearly parallel with the convexity of the termination of the nails, taking the circular direction of the ends of the fingers; by this arrangement, a centre of circles is produced nearly opposite to the roots of the nails, having one or two perfectly concentric turns; after which, they incline towards the sides of the fingers: below these concentric turns, the rugæ are again nearly parallel with the joint of the phalanges, while in the palms of the hands they assume various directions. The rugæ are studded at various distances on their projecting surfaces with perspirable pores. (*Vide Plate* II. *Fig.* 1.) On the tips of the fingers, where the sense of touch particularly resides, small projecting papillæ are frequently seen between the rugæ, being about one third of their breadth, and on which no pores are perceptible: whether these shield the sentient extremities of the nerves of the sense of touch in any particular manner, is a mere subject of conjecture; but they are not met with in any other situation. (*Vide Plate* II. *Fig.* 4.)

The appearance of the cuticle on the backs of the fingers, is very different from that above described; the rugæ, instead of being disposed in parallel directions, are broken into innumerable small portions, the surfaces of which have a vermicular appearance, variously contorted. On the back of the hand, the arrangement of the rugæ is not so distinct, being crossed by innumerable wrinkles adapted to the elasticity of the skin; which rugæ, meeting in various directions, divide the surface into minute angular portions. By a microscopic examination, the same structure, as described above, appears to appertain to the skin generally, but is rendered less apparent by the cuticle being more loose on those parts which have most motion. It is apparent on the backs of the fingers, and more especially over the joints of the phalanges. The manner in which the papillæ are arranged in the diamond-shape on the back of the hand, is represented in the proportion of one inch to one-eighth of an inch in *Plate* II. *Fig.* 2; but not being sufficiently distinct, it is enlarged in *Fig.* 5.

In the formation of new cuticle, we may gain a very fair idea of its structure, and original growth; at the same time proving that it is not, as is described by Leuwenhoeck, formed in scales. A thin transparent layer is first perceived, which becomes thickened by a succeeding layer formed underneath it; these layers continue to be deposited upon the surface of the rete mucosum, until they have acquired a thickness corresponding to the pressure to which each part of the body is subjected. From this structure it results, that the under surface of the cuticle, however thick the cuticle may be, exactly corresponds in structure with the external surface. This conformation is evinced by those preparations of thickened cuticle taken from the heel, or any other part of the body exposed to great pressure. In these may be observed, on the under surface, furrows or depressions, corresponding with the elevated rugæ on the upper; and the perspiratory pores may be more distinctly seen from the processes of the cuticle, which pass with them into the cutis.

(*Vide Plate* II. *Fig.* 6.) In the cut edges of these thickened portions of cuticle, the perspiratory pores may be seen to take a perpendicular direction through its substance; which circumstance further proves, that the layers of cuticle are not deposited in scales.

No blood-vessels, nerves, or absorbents have been traced to the cuticle; hence it has been considered as an inorganized substance: but the vitality it possesses is apparent, from the important functions it assists in, from its growth, and from its death and separation when injured, like other structures in the body. In fact, it is difficult to believe that any part can be inorganized as long as it performs the functions for which it was constructed. To this vitality we may refer the remarkable property of the cuticle which it possesses, of allowing the exhalents to transpire various fluids through its pores; which property is immediately suspended when the cuticle is raised from the surface of the skin underneath. The serum of a blister is confined by the cuticle, notwithstanding considerable pressure, as in blisters of the feet from walking. Physiologists have assigned various reasons for this phenomenon; namely, that the cuticle, when detached, breaks away portions of the cutis, which close its pores; again, that the cuticle, being elastic, closes its pores by contraction in its detached state; and further, that the pores, passing in an oblique direction, are thereby closed by the distention of the blister: actual examination does not corroborate either of these conjectures; the pores of the raised cuticle do not appear to be closed by detached portions, nor does the surface of the cutis exhibit any such lacerations; the cuticle is by no means so elastic as the cutis, and its pores pass in a perpendicular direction. One fact is worth a thousand conjectures: the cuticle, when detached by a blister, loses its vitality, and with it the power of function.

The skin, independent of its forming a suitable covering to the body, has important functions to perform, intimately connected with the animal economy. Its function as an

organ of touch, we have already partly considered with the structure particularly destined for this sensation; we may, however, further remark, that although this sense has a greater power in particular situations, its general distribution in every part of the skin, is of the utmost importance as a source of protection, by the information which it communicates in cases of danger: this is evinced by the sudden and universal sensation occasioned by the slightest touch of such objects as, from their nature, are considered hurtful to the human body. Morbid sensibility of touch, in some individuals, exists to a very great extent upon the contact of certain objects, which are to others perfectly innoxious; such I have known to be the case in a sensation communicated from the skin of the cat, of a peach, and the leaves of such plants as have minute hairs.

The principal function of the skin, is the important secretion of perspiration, which, in a healthy individual, is constantly going on insensibly, in a state of vapour; but when this secretion is accelerated by violent muscular exertion, accompanied by quickened respiration, the perspiration is poured out in the visible form of sweat. This answers a very important purpose, by preserving the temperature of the body, which otherwise would be so greatly increased by muscular exertion, as to produce the most painful effects. The great power which the perspiration has in reducing the temperature of the body, is witnessed by the high degree of heat which glass-blowers, and men in iron foundries, are capable of sustaining; and in all such instances, perspiration flows in streams from the surface of the skin. Dr. Fordyce, and Dr. Blagden, made experiments to ascertain what was the degree of heat the body was capable of bearing; in these experiments, it was found that, in a room heated to the temperature of 264° of Farenheit's thermometer, respiration could be carried on without any particular distress after perspiration had broken out upon the skin.

In these experiments, we must remark the effect produced by perspiration in preventing the increase of the heat

of the body beyond that point which would prove injurious. At the time the temperature of the room was raised to 264°, the heat of the body itself never rose above 102°—its natural temperature being 98°; which, in fever, is rarely or never raised above 101°. This vital regulation of temperature resident in the skin, in some instances would appear not exactly to depend upon the mere process of evaporation producing cold, as frogs and fish are capable of maintaining a standard temperature of body in water of a much higher temperature.

Occasionally in fevers this function of the skin seems to be suspended, particularly in fevers of a typhoid character; when the great heat of the skin will communicate to the touch of a healthy person the sensation of a burning surface; in such instances, relief can only be obtained by the application of artificial cold and moisture; and nothing can exceed the pleasurable feelings of persons thus relieved from the insupportable heat of the body.

The quantity of perspirable fluid secreted from the skin of a healthy subject in a given time, under the different states of rest and exertion, has been the subject of various experiments, by different physiologists. Mr. Cruikshanks placed his arm in a glass vessel, and found that, in the space of one hour, twenty grains of perspiration were given off; he repeated the experiment, but now walking about, and in one hour forty-eight grains were produced from exertion; thus making the difference of rather more than one half. Mr. Allen tried this experiment, subjecting a glass tube in which his arm was enclosed, to a high degree of heat; when the perspiration became excessively profuse.

Another important function is referable to the skin, wherein it answers a somewhat similar purpose to respiration; and, like it, appears to assist in decarbonizing the blood. This is found by the precipitation of a carbonate of lime, when the hand, in a state of perspiration is immersed in lime water; or if the lime water is exposed to air which has been for a length of time confined upon a surface of skin. These

are similar results to those produced by subjecting lime water to the action of expired air. May not this decarbonizing function principally depend upon the venous structure which characterizes the rete mucosum immediately under the cuticle? As in the lungs, we find the veins bringing the blood to be exposed to the air within its cells, so in this venous distribution, it is exposed to the action of the air on the surface of the body. The parts are too minute to demonstrate the particular mode of the contact and connection between the venous distribution and the air; but this structure of veins, and the known function which is performed by the skin, have so strong an analogy with respiration, that I cannot help throwing out the conjecture of their identity.

The chemical analysis of perspiration shews, that it has various compounds; Dr. Anselmino, according to Richerand, states it to consist of—

Calcareous salts - - - - - - -	0	02
Animal matter with the sulphate	0	21
Osmazone and chlorurets of soda and of lime - - - - - - -	0	48
Osmozone combined with the acetates and free acetic acid	0	29
	0	100

The skin also secretes an oily matter, which may possibly be an exudation of the subcutaneous fat, as it is found most abundant in corpulent people; it is of a greasy nature, burns with a white flame, and leaves a carbonaceous residuum; it appears to serve the purpose of protecting the cuticle from the effects of the more fluid exudations of perspiration, as well as the moisture of the atmosphere; to this secretion is owing an effect seen in bathing, when the water may be observed to hang in drops upon the surface of the skin of the back, and to trickle off in parts without leaving the skin wetted.

There is, further, a secretion from the sebaceous follicles,

of a thicker consistency, and more of a ceruminous nature, which appears also to be for the purpose of protecting the skin from the irritation of its own accumulated secretions.

From the foregoing considerations of the many important functions performed by the skin in its various secretions, we have a strong proof of the necessity both of air and exercise to maintain the healthy state of the body; and for the same reason, indolence of habit, and the various indulgences which luxury resorts to, are so many means which contribute to an unhealthy state of the system. This is proved by the sympathy which exists between the functions of the skin, and those of other parts: and such a reciprocity of action takes place between them, that the health of one depends upon the natural action of the others.

Considerable doubts have been entertained respecting the absorbent power of the skin; it has however been pretty clearly proved, that, although incapable of absorbing fluids, gazeous substances may by this process be taken into the system. The fact of chlorine depriving the rete mucosum of colour in the Negro, proves the existence of cutaneous absorption. Sir Astley Cooper, who has paid much attention to this subject, seems inclined to believe that the cuticle offers a strong resistance to absorption; and that unless it is abraded, by friction or otherwise, cutaneous absorption does not take place. Those who are of a different opinion, instance the urine becoming tainted when the hand has been immersed in turpentine; but by numerous experiments, it has been proved, that this effect does not take place, unless the vapour arising from the turpentine has, at the same time, been inspired: and again, that persons jumping into cold water in a state of extreme thirst; being relieved from this situation, is not to be considered as depending upon the absorption of the fluid, but upon the effect of cold; which, under all circumstances, lessens the sensation of thirst.

The development of the skin commences at a very early period after conception; in the embryo, it is first discoverable about the fifth month, when it is of a rosy tint; the

sebaceous follicles make their appearance about the same time, and are seen, first about the head and face, and then in other parts of the body. About the seventh month, the skin is covered with a sebaceous secretion, which remains until the time of birth. In new-born children of Negroes, the skin is of a redder appearance than in Europeans; the black colour begins to shew itself the moment the child respires, but is more particularly apparent towards the third day after birth; first around the nails, nipples, organs of generation, anus, and eyes; about the seventh day, the colour becomes general. It may be here remarked, in addition to what has already been said on the subject, that the rete mucosum has an intimate connection with respiration.

The diseases of the skin, as might be supposed from the variety of functions which it performs, are very numerous, and seem principally to depend upon those causes which diminish the quantity and quality of its secretions: hence it is, that we find persons who take but little exercise, and consequently perspire but little, are the most liable to cutaneous eruptions. These diseases put on various appearances, and are accompanied with such different symptoms, that those who have made them a subject of particular interest and study, have divided them into many orders, species, and varieties, which form a lengthened and intricate nomenclature.

In injury to the cutis from mechanical lesion, there is a power of reproduction resident in the vessels of the skin; and if the division has occurred from a cutting instrument, and the parts be brought in contact with each other, a union quickly occurs, which is termed adhesion by the first intention; a small cicatrix is formed by the deposition of coagulable lymph; and then the cuticle is quickly formed over it; gradually acquiring all the physical properties of the old skin.

When the wound is extensive, the power of reparation is slower, and a better opportunity is afforded to watch the phenomena as they proceed; they will be found to occur in the following order: first, the deposition of an agglu-

tinous fluid, probably only the serum of the blood over the whole surface of the wound, being apparently inorganised; secondly, it shews signs of organization in the formation of circular granulations, which secrete more or less pus, and becoming gradually contracted on their surfaces, put on the appearance of a mucous membrane; when, lastly, cuticle is secreted, and cicatrization completed. When this process is first completed, the new-formed skin does not possess the same properties as the old skin, being less elastic, of a more opaque colour, and through life remains more liable to ulceration. This is the case with respect to the new formation of every structure in the body, as well as that of the skin; for it has been found in bad cases of scurvy produced by long voyages, that not only old cicatrices have re-opened by the ulcerative process; but that united fractures of long standing have also become again separated. This tendency to ulceration, depends apparently upon newly-secreted structures never becoming so vascular as when originally formed.

It is believed by some and denied by others, that the rete mucosum is regenerated in cicatrices; Camper is of opinion, that it is not, and instances it by the assertion, that cicatrices in Negroes remain of a white colour; this is not admitted as a fact by others; who assert that it is only an alteration in the degree of colour, and producing therefore only a different shade; which may arise from the new rete mucosum, like the cutis, being less vascular.

There are various opinions with respect to the formation of new skin; whether or not the vessels from granulations are capable of producing it; or whether it can only be formed from the vessels of the old skin: and it is usually believed, that portions of new skin, which are frequently formed in the middle of old ulcers, are never generated into cicatrix, but become absorbed; and that the formation of the cicatrix must take place from the circumference of the sore, and from the edges of the old skin. As far as I have observed, this depends upon the depth more than the extent of sur-

face in the wound; for if the cellular membrane is left, or regenerated, so as to cover the muscles and subjacent structures, then new skin can form on any part of the wound, although it will always generate quicker at the edges of the old skin; hence the use of approximating them during the healing of a large ulcer.

Bandaging also assists in the reproduction of skin, by subjecting the cellular membrane to its natural pressure.

The similarity of structure between the cutis and the mucous membranes, is rendered very obvious, both in disease and in reproduction. As has been remarked, newly-formed cutis, just before it becomes covered by the cuticle, has all the appearance of mucous membrane; and mucous membranes themselves, when exposed to the atmosphere, and being no longer capable of performing their natural functions, become covered with cuticle; this I have frequently seen in prolapsus ani: and Dr. Blundell told me of a case of procedentia vaginæ, where the protruded mucous membrane was not only covered with cuticle; but that a rete mucosum was also found, giving to the part the colour of the skin of the scrotum and prepuce. In extensive burns, also, where a diseased action is set up, and cuticle is not reproduced, the cutis not only has the appearance, but also more or less the function of mucous membranes, lubricating its surface with a muco purulent secretion.

The skin is also the original seat of disease, arising from the obliteration of the excretory canal of the sebaceous follicles; from which circumstance, accumulations of the secretion will frequently occur, forming what are termed, when they acquire large size, an encysted tumour: not that I believe encysted tumours are always so produced; for, in some instances, the cyst as well as the secretion seems entirely adventitious. In these follicular tumours, when small, the secretion may usually be pressed out of the duct, the situation of its opening being apparent, from a little dark spot produced by the exposure of its secretion to the air: and when they have acquired even the size of a walnut,

the duct may generally be discovered, and a probe pushed into the sac; after which it may be emptied of its contents: but when they are very large, it is necessary to remove the sac, to ensure a radical cure.

The varieties of colour of the skin may, perhaps, be considered entirely to depend upon the development and function of the rete mucosum; and there seems to be no circumstance which tends more to strengthen this supposition, than the facts connected with that peculiarity of colour constituting what is termed the Albino. In them the colour is a dull reddish white, the hair nearly colourless, and the eye red; these appearances are supposed by some physiologists to depend upon the absence of the rete mucosum, and pigmentum nigrum of the choroid coat of the eye. Whether this state is to be considered as disease, or malformation at birth, is yet a matter of doubt; the regularity of the other functions of the body, notwithstanding the greater susceptibility of the eye to light, and the diminished power of function in the skin, shews rather that this peculiarity is not depending on disease.

This peculiarity is a variety which occurs among all races of mankind, and appears to be the same in white rabbits, and many other animals.

There are certain spots which occasionally occur in the skin, on different parts of the body, which, upon dissection, shew a darker structure of rete mucosum. I am inclined to consider those patches which are termed aneurisms by anastamoses, as depending upon a varicose state of the vessels of the rete mucosum; particularly from the ready manner in which they are fed from neighbouring vessels, as it were from a net-work, and which cannot be cured without the total eradication of the whole mass.

Some of the appearances in melanosis, also lead me to suspect, that they have some reference to a diseased function in the rete mucosum.

The cuticle appears to be variously diseased, and different views have been formed by those who consider it as merely

a secretion from the skin, and those who believe it to possess an independent organization. As a covering to the body, its principal office seems to be, to defend the more sensitive integuments underneath from the action of the atmosphere; hence the great suffering which is produced merely by the loss of a small portion of this protecting medium; and the cause of death in extensive scalds, and burns, appears generally to depend upon the irritation of the air upon the exposed surface, which produces such violent effects, that the constitution sinks under it. The peculiar power which the cuticle possesses in resisting the drying effects of the atmosphere upon the cutis, exists for a considerable length of time, even after death. I placed a piece of skin in the sun, one half of which was denuded of its cuticle, and which dried up into a kind of horny substance, in the course of a few hours; while the other portion, from which the cuticle was not removed, remained for three weeks very little altered, the cutis remaining underneath in its natural, soft, and pliant state.

The cuticle, the hairs, and the nails, appear to possess a remarkable variety from all other living structures, in not being absorbed after formation. Nature appears to have provided for this by the constant desquamation of their exuberant growths; with respect to the cuticle, in the human subject, this may be readily seen, in those parts where it accumulates in the greatest quantity, as in the scalp, feet, palms of the hands, and other parts of the body, from whence it is abundantly detached by friction, and more particularly when separated by warmth and moisture; and in reference to the hair and nails, from the constant necessity of keeping them short by cutting. This separation of cuticle in many reptiles takes place at stated periods, by a general removal from the whole surface; and it is remarkable, that, in such instances, the cuticle is detached from the surface of the eye, shewing its transparent formation over that delicate organ; which fact offers an objection to those

theorists who assert, the cuticle to be a mere secretion from the cutis.

The cuticle, in some serpents, is separated from their bodies as often as once in two months; while in other animals, as in the crustacea, and certain insects, it appears to occur but once in a year; during which time, the torpid state tends to diminish their respiratory function until the new cuticle is devoloped.

The cuticle has a remarkable power of reproduction, as may be seen from the quick manner in which it is capable of furnishing a new covering over denuded surfaces.

Pressure has an effect in producing the growth of cuticle, as is seen by its great thickness in the palms of the hands, and soles of the feet; but in certain instances, from malformation of the feet, pressure will be thrown in an undue proportion on certain parts: this occasions so great an increase of cuticle, as to amount to a disease on that part, and can only be relieved by the removal of the whole surface of the thickened cuticle, by repeated applications of blisters; and when this has been accomplished, it is necessary to protect the denuded part from pressure, by mechanical means, for a considerable length of time, otherwise the superabundant and hardened cuticle will re-form with great rapidity.

Corns are of a similar nature, and the tendency to their formation, and their growth, is in a like manner owing to pressure; the method used by Chiropodists to extirpate them is, first to soften the skin by immersion in warm water, then with a blunt knife to detach and raise the cuticle a little distance from the circumference of the corn; which operation, being continued, the corn is gradually separated.

A hardened prolongation of a substance of the nature of cuticle, will sometimes grow from the skin, and most frequently from the scalp; they have been termed horns, but appear to depend upon an accumulated secretion from the surface of an ulcerated sebaceous follicle, and not, as has

been supposed, from a morbid secretion of cuticle: these sometimes acquire a considerable size, and curl round in resemblance of a ram's horn. They are easily removed, but are usually supplied with a blood-vessel of a considerable size.

ANATOMY OF HAIRS.

The hairs and nails are termed the appendages of the skin; the former, however, do not arise immediately from the skin, but from the cellular membrane beneath it; projecting more or less beyond the inner surface of the cutis, according to their size and stiffness.

The structure of a hair is as follows:—It is formed of a cylindrical tube, of a horny consistence, pointed at its free extremity, and terminating in a soft bulbous enlargement at its attachment, containing a gelatinous lymph. This bulbous enlargement is of a lighter colour than the lengthened tube which proceeds from it, and has a perforation rather to one side of the bulbous extremity, where it is soft and pulpy, and encloses the vessels which communicate with the membrane that lines the interior of the tube. From this membrane, and more particularly that part within the bulb, an oleaginous fluid is secreted, which communicates colour to the hair; being of different shades, from a transparent white to a jet black tint.

The bulbous extremity of the hair is enclosed in a membranous sheath and capsule, which is closely connected with the cutis and cellular membrane. Several small filaments pass from the membranous sheath, called its roots; these form a firm attachment for the hair, and probably contain vessels, which furnish the oily secretion of the membrane of the internal tubular cavity.

Anatomists have enumerated other structures connected with the bulb: namely, a second membrane lining the capsule, of a red colour, soft and thin, and said to be a continuation of the rete mucosum: and within the cavity of the bulb, numerous conical papillæ, which are attached to the sides of the cavity at their bases, having their apices free

and pointed towards the aperture of the bulb; also sebaceous follicles, nerves and blood-vessels distributed within the bulb. Of my own knowledge, I cannot say that such numerous structures are to be discovered in the human hair; and rather suspect, that these descriptions are taken from the formation of the feathers of birds, or the large feelers or bristles which serve particular purposes in different animals. If you pull out a hair, it generally brings along with it the membranous sheath of its bulb, and the pulpy roots attached: these may be scraped off, when the form of the bulb is apparent, of a white colour, and having a soft filament still adhering at the extremity or entrance to the bulb.

In those animals which have feelers attached near their noses and jaws, the bulbous extremity is enclosed in a tendinous sheath, which is again enveloped in a sheath or capsule of a cartilaginous consistence: these capsules are open at each extremity; externally, to enclose the tube of the feeler; and internally, to admit of the nerves and blood-vessels which are distributed to them. The space between the two capsules is lined with a vascular membrane, giving it a complete red colour, and is filled with a limpid watery fluid; in which, and on the membrane, an abundance of nervous filaments are distributed. In this cavity the bulb of the feeler is moveable; and being confined by the enclosure of cutis immediately above the cartilaginous structure, the motion at the free extremity of the feeler is communicated to the fluid enclosure, and delicate nervous filaments enclosed within it. From the extraordinary size of the nerve, and its termination in a watery medium, it is not improbable that a sense similar to that of hearing may be communicated by this curious structure. The bristles or feelers are erected, turned in various directions, or fixed, by numerous minute muscles attached to the cartilaginous capsule: and it is remarkable, that the minuter hairs around the feelers are arranged diverging from their entrance to the skin, so as not to interfere by contact with the more delicate motions communicated from without.

Great variety is presented in the form and texture of the hairs of different animals, as well as on different parts of the same animal: a similarity of structure, however, probably appertains to all; not only in the different sorts of hair, wool, fur, and bristles of the porcupine, but in the feathers of birds.

It is generally supposed that the hairs, in passing out of the skin, receive a covering from the cuticle, which accompanies them to their pointed extremities: this covering I have not been able to trace, and rather doubt its existence from the following circumstance:—The hair in the progress of its growth, when it has passed through the cutis, is arrested in its passage by the cuticle, and will make several coils and turns underneath it—which it would not do, if its covering was in the nature of a prolongation extending from the cuticle. These may be readily seen on the back of the arm of a hairy person; and on breaking away the superstructure of cuticle, the young hair will spring up, uncoil, and soon assume the direction of the neighbouring hairs. The length of the coiled hair, is from one to two-eighths of an inch. I am equally doubtful of the covering of cutis, said to extend underneath the bulb, by a process passing in an opposite direction to the cuticle. In the larger hairs or bristles, the attachment is only at the anterior surface of the cutis, where the upper portion of the bulb and tubular parts are firmly enclosed.

The hair presents several varieties of texture in the human subject, and is much more abundant in some situations than in others. Its greatest accumulation is upon the head, where it is much longer in the female than in the male; and by its flowing length and graceful curls, forms a principal feature of beauty.

Hair of a stronger texture, and more inclined to short curls, forms the beard, which is found only in the male; while hair of intermediate texture grows in abundance on the pubes, on the scrotum, the labia, in the arm-pits, and, in the male, around the anus; and more abundantly on the

front than on the back part of the body, and on the anterior than on the internal parts of the arms, thighs, and legs; on the backs of the hands, and back part of the bodies of the third phalanges of the fingers and toes. There is, however, a great difference in the abundance of hair in separate individuals; while some have the hair so abundant, not only in the above-enumerated situations, but generally over the body, excepting only a small portion of the face, palms of the hands, and soles of the feet; others are as free as the female from such growths. Besides the above situations, short hairs of a peculiar character form the eye-lashes, others the eye-brows; others are situated in the nostrils, and on the inside of the tragus and antitragus of the external ear. There is also a peculiar, fine, colourless, downy hair, which is found on infants at their birth; this generally comes away during the first month, giving place to newly-formed hairs; in others, it remains many months; and, in some instances, does not appear ever to come off. Fine downy hair of this last description, is commonly seen on the arms and necks of young children, and interspersed generally among the other hairs of the body in the adult. When the cuticle comes away from putrefaction, it separates this fine hair with it; while those of larger structure remain in the cutis.

The colour of the hair in the same individual is generally alike, or nearly so, in all the different parts of the body; they are not however developed in all parts at the same time. The colour also varies at different ages.

In the fœtus, the hairs are generally of one size and colour; after birth they grow faster on the head, while in other parts they appear only at the age of puberty. The colour becomes stronger and darker with increasing age; in old age they again turn white, and secrete a colourless oil; their bulbs appear to dry away, and they drop off in abundance: this change, constituting baldness, is often hereditary, and will commence as early as twenty years of age.

The particular use of hair in the animal economy, is not clearly ascertained, particularly in man, where it does not, as in animals, eontribute so much to the warmth of the body.

It has a particular attraetion for moisture, which swells and lengthens it. It is among the most indestructable parts of the body, and powerfully resists putrefaetion. Alkalies soften and dissolve it; henee the advantage gained by first softening the beard by the use of soap, in shaving.

The appendages of the skin, the hairs, and nails, although different formations, appear to be modifications of the same substance as the cuticle; on being burnt, they each emit the same odour; the hoofs and horns of animals, the feathers of birds, are alike in this respect, and leave the same residuum of phosphate of lime. Human hair when burnt, leaves the hydro chlorate of soda, the carbonate, sulphate, and phosphate of lime, and a small quantity of oxyde of manganese. In white hair phosphate of magnesia, and in black hair a considerable quantity of silica are found; while in the red and light-coloured hair, sulphur is detected.

It has been conjectured, that the hair is an excretory to the superabundant phosphate of lime in cireulation: and to strengthen this conjecture, it has been remarked, that the urine of quadrupeds abounds less in phosphoric salts, than human urine.

The hair is supposed by some to have a power of erection in extreme fear; but this does not appear to depend on any thing beyond the contraction of the occipito frontalis, which draws the scalp and hairs along with it. In quadrupeds, also, the effect appears to be produced by particular muscular action; and not upon a spontaneous motion inherent in the hairs themselves.

Various aceounts have been given of the hair of the head turning white in the course of a single night; there has been, no doubt, much exaggeration in the history of these faets; nevertheless, many of them are so well attested, that there can be little doubt that the hair will turn white, more particularly in young people, in the course of a few

days; many such instances were witnessed during the French revolution, although we are not able to account for this change.

The hair is said to undergo a morbid change in its secretion, and that in the disease named plica polonica, when cut near to the skin, blood will exude from the cut extremities; this accumulating, the hairs will be all matted together: but it is probable, that the mere filth of the Poles, among whom this disease is most common, is the sole cause, as its cure has been effected, simply by cutting off the hair. Certain fatty tumours have been found to contain hair, mixed with the sebaceous matter; again, they have been found in ovarian cists; in such cases, they are, however, connected with accidental cutaneous formations. After fevers, it will frequently come off in abundance; nevertheless, like cuticle, it will form again readily, particularly in young persons.

Inveterate headaches have been cured by frequent cutting of the hair; which may probably act like a blister, by calling a new action to the part, as the more frequently hair is cut, the faster it will grow.

ANATOMY OF NAILS.

The nails, the next appendage of the skin, are situated on the dorsal surface of the extremities of the fingers and toes. They are of an oblong, or irregular oval form. They appear to be of the same substance as the cuticle, only of a denser structure.

They are formed of thin plates, of a horny consistence, slightly arched or convex exteriorly, and concave internally.

They are divided in three portions, the root, the body, and the free extremity. The root is the thinnest and softest, and amounts to about one-fifth part of the whole nail.

The root commences in a semilunar groove of the cutis, from which it soon emerges, and then adheres to the cutis only on the inner surface of its body. The nail then projects through the cuticle, making an aperture in it corresponding with the two sides, the under portion of the free extremity, and the external portion of the root at the groove of the cutis. The cuticle, as it approaches the root of the nail, makes a duplicature beyond the edge of the groove of the cutis, thus forming a ridge of cuticle which is seen at the base of the nail; it here appears to divide, sending a thin process which spreads, projecting forwards, on the surface of the base of the nail; and another which passes downwards into the groove of the cutis; (*Vide Plate* II. *Fig.* 15. *a.*) at the side of the nail, it curves round from the part included in the groove, continues along its sides, and passes inwards from the tip of the finger, some way under the free extremity of the nail; this structure is seen at *Plate* II. *Fig.* 15. *b.* The firm adhesion of the cuticle to the nail, and the manner in which the nail perforates the cuticle, is easily seen when the nail is separated in maceration. As the nail passes from the

groove in the cutis, it becomes thicker, until it emerges from the cutis; after which it continues of nearly a uniform thickness to the extremity. It is firmly attached to the cutis by numerous longitudinal ridges and depressions, which are closely connected with corresponding ridges and depressions in the surface of the cutis; a horizontal section of this connection would present a junction analogous to a suture.

The nail is of a semitransparent colour, and shews the vascular cutis underneath, excepting near its root, where it is opaque, and of a white colour; this white part commences at a point on either side, and becomes broader in the middle; hence it forms a semilunar arch across the root of the nail. Portions of this white structure will occasionally appear in other parts of the nail, and will gradually reach its free extremity, and disappear with the exuberant growth of the nail.

The nails appear about the fifth month in the fœtus, and are but partially developed at birth, when they do not project above their bodies; hence they have no free extremity, which is an admirable provision for the protection of the parietes of the uterus, which would be liable to injury from the motions of the fœtus if its fingers and toes were armed with projecting nails. The cuticle joins the nail at its extremity, and moreover projects with the tips over the nail, so as to form a cushion around it. (*Vide Plate* II. *Fig.* 13. *and* 14.)

The nails have little or no sensibility, and may be cut without communicating pain; their nerves, or secreting vessels, have not been detected. They appear to be secreted from their roots enclosed in a groove of the cutis, from which point they are continually increasing, and if not cut, would extend at their free extremities several inches in length, as has been observed in some Indian devotees.

When separated from accident or disease, a new nail will readily form; but it will not be so thick and strong as the original, will be more susceptible of injury, and will more easily separate again.

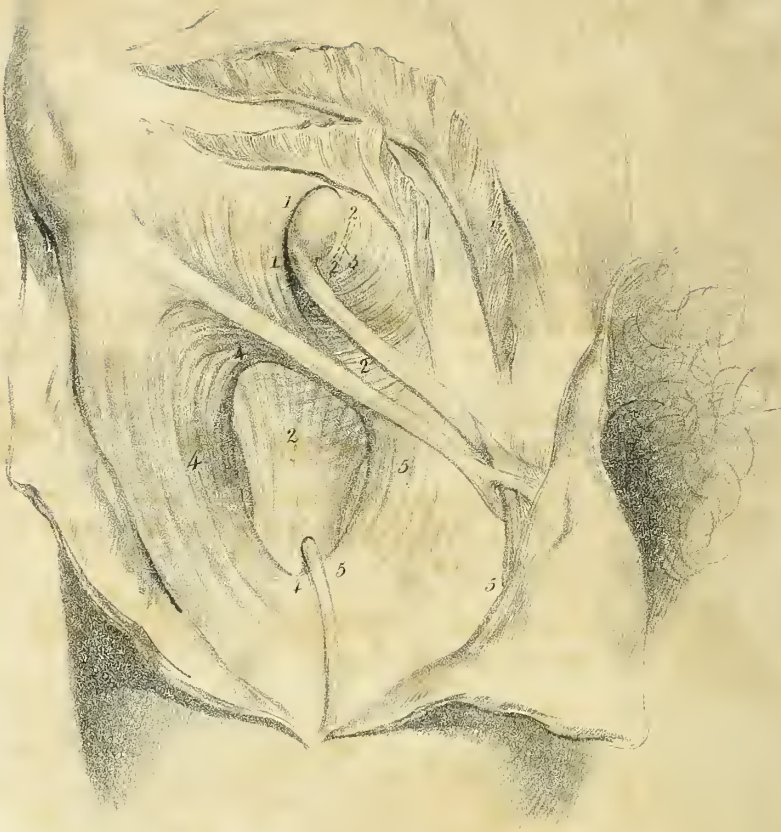
The part from which the nail grows has been termed by

Sir Astley Cooper the ungual gland; who remarks, that a notch made in the root or base of the nail, will be three months growing out; from whence we may conclude, that the nails renew themselves about four times in the year. The nails very often grow into the sides of the fingers and toes; but more particularly in the latter, from the increased pressure of tight shoes. In young persons, this may be relieved by scraping the nail thin; cutting a notch in its free extremity, and by placing a small portion of lint under the pressure; where this will not succeed, it is necessary to pass a small pair of scissors under the nail, and detach a slip from one side, which will effect a cure. In elderly people, this would be attended with danger, and must not be attempted, from the languid circulation, and consequent tendency to gangrene in their lower extremities.

The nails occasionally will grow to a certain distance, when ulcerations will form under them; this disease is often difficult to cure, and cannot be effected until the ungual portion of the nail is destroyed,—an operation attended with excessive pain. An application of arsenical ointment placed above and under the nail, is perhaps the best mode of effecting their separation.

END OF VOL. SECOND.

Plate I.



F. Warr lith.

PLATE I.

1. 1. Outer margin of the internal ring, formed by the iliac portion of the fascia transversalis.

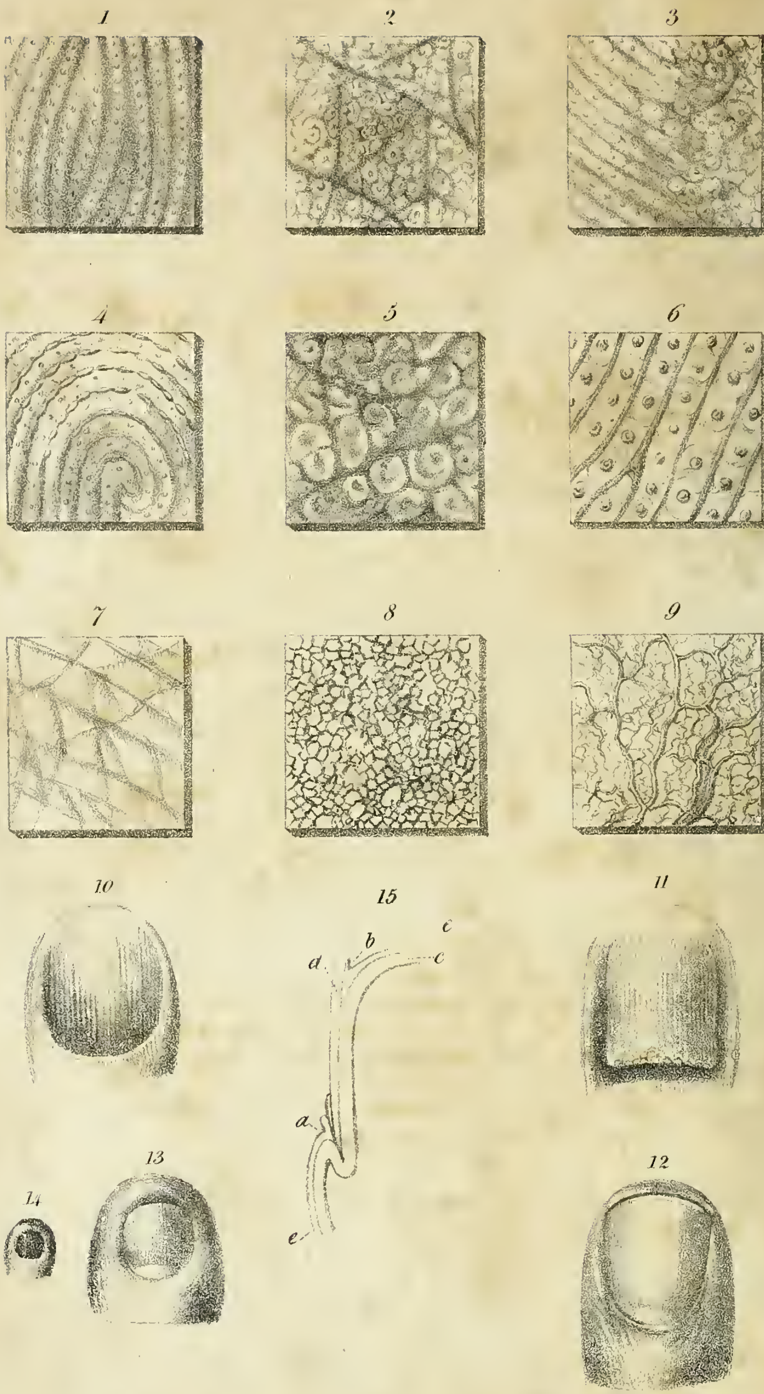
2. 2. 2. 2. Inner margin of the internal ring, formed by the pubic portion of the fascia transversalis.

3. The epigastric artery, seen through the semitransparent pubic portion of the fascia transversalis.

4. 4. 4. The iliac portion of the fascia lata, forming a crescentic edge about an inch and a half below Poupart's ligament.

5. 5. 5. The pubic portion of the fascia lata, seen uniting with the iliac portion.

Plate II.



H. J. Shrapnell Fec.t

F. Warr lith.

PLATE II.

Fig.

1. External view of a portion of cuticle from the palm of the hand, shewing the manner in which the papillæ, or rugæ, are arranged parallel to each other.
2. Surface of the cuticle from the back of the hand, magnified in the proportion of one inch to one eighth of an inch.
3. External view of the cuticle from the side of one of the fingers, shewing the manner in which the arrangement in Fig. 1 and 2 blend into each other.
4. External view of the cuticle from the tip of one of the fingers, shewing minute papillæ between the parallel distributions.
5. Similar view to Fig. 2, magnified with a higher power; the arrangement of the papillæ in this view, is very similar to the structure of the under surface of leaves.
6. Internal surface of the cuticle from the palm of the hand, shewing the openings made through it by the perspiratory pores.
7. View of the external surface of the cutis—magnified as in Fig. 2.
8. The venous distribution of the external surface of the rete mucosum, from a preparation in the Museum at Guy's Hospital—magnified in the same proportion as Fig. 2.
9. The arterial distribution, from a finely injected preparation by Sir Astley Cooper, in the Museum at Guy's Hospital. This arrangement of vessels appears to be underneath the net-work of veins represented in Fig. 8.
10. Surface of the cutis, and the groove which receives the attachment of the nail.
11. The corresponding internal surface of the nail, with the cuticle attached.
12. External view of the nail.
13. Enlarged view of the fœtal nail.
14. Natural size of the fœtal nail.
15. A section to shew the manner in which the cuticle is attached to the nail and cutis, and the commencement of the nail by a thin portion in the groove formed for its reception in the cutis.

    a. Cuticle, forming a duplicature at the root of the nail.
    b. The same in its free continuity.
    c. Cutis.
    d. Nail.
    e. e. Cuticle.

F. WARR, PRINTER,
RED LION PASSAGE, HOLBORN, LONDON.